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AN INVENTORY OF THE SPRING CREEKS IN MONTANA

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By

Janet Decker-Hess

January, 1986

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May, 1989

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AN INVENTORY

OF THE SPRING CREEKS

IN MONTANA

By
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Prepared for

The American Fisheries Society
5410 Grosvenor Lane
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ABSTRACT

An inventory of the spring creeks in the state of Montana was conducted in 1985. Nearly 70 spring creeks were visited during the project's duration. The site visits included description of channel characteristics, riparian zone health and species composition, and land use practices. Existing physical, chemical, and biological data were later gathered from state and federal agencies, private consultant groups, and non-profit organizations. The majority of the creeks were located in the southwest region of the state in the upper Missouri River drainages and the Yellowstone River drainage. Major land use activities along the creeks were generally agriculturally related, including cattle grazing and hay production. Stream flows are diverted for irrigation and channels shuttle water from other sources. Extensive deterioration of instream habitat and loss of riparian vegetation has been caused by existing land and water uses. As a result, the majority of Montana's spring creeks are not meeting their fishery potential. Poindexter Slough is the only spring creek owned by the state and purchased for public use. The remainder are in private ownership and require permission from the landowner or payment of a trepass fee for fishing. Management alternatives were recommended on each inventoried creek.

Major rehabilitation projects conducted by the private and public sector occurred on several spring creeks since the original inventory in 1985. Spawning opportunities to main stem trout populations have been expanded and resident populations increased as a result of the rehabilitation projects.

ACKNOWLEDGMENTS

An inventory of this nature is not possible without the help of many individuals. Personnel from the Montana Department of Fish, Wildlife, and Parks contributed countless hours to the original inventory and update. George Holton's interest in Montana's spring creeks led to invaluable assistance in the collection of existing data. Ron Marcoux's initiation of a spring creek inventory in 1979 contributed insights from a statewide perspective. Department fisheries biologists and managers aided in data collection and reviewed the write-ups for the update. US Forest Service and Bureau of Land Management fisheries biologists were also contacted in the initial inquiries concerning spring creek location.

Thanks are extended to the entire Region 3 fisheries staff where 70% of the spring creeks in Montana are located. Site inventories in this region would not have been possible without the assistance of Chris Clancy, Fred Nelson, Dick Oswald, and Bruce Rehwinkel.

A special thanks to the Special Projects office in Kalispell for allowing the use of the computer to type the manuscript and use of their office space and equipment.

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INTRODUCTION

Spring fed streams are a unique and rare ecosystem, offering a combination of productive waters with relatively constant temperatures and flows. They provide very uniform conditions in areas which are subject to great seasonal changes (Hynes 1970). They may be inhabited by relect species of former times having survived through protection from cold winters or warm summers, as the case may be. Although the number of species inhabiting spring creeks may be restricted because of the uniformity of the temperature, total biomass and growth usually far exceeds surface streams in the area. In Montana, several spring creeks have gained national recognition as a result of their productivity.

An inventory of the major spring creeks in Montana was completed in 1985. The inventory was reviewed and updated in 1989. No major survey of this resource has previously been conducted. An informal questionnaire was circulated in 1979 by Montana Department Fish, Wildlife, and Parks (MDFWP) fisheries personnel (R. Marcoux, pers. comm.). Information was requested by region on the major spring creeks. Less than 30 creeks were listed. Berg (1975), as part of a larger study, investigated several spring creeks in the upper Yellowstone drainage. Clancy (1984 and 1985) continued and expanded the spring creek inventory in the Yellowstone, emphasizing off-site values to main stem spawning trout. Several spring creeks in the Madison and East Gallatin River drainages have been included in MDFWP instream flow requests (MDFWP 1979 and 1981).

The majority of Montana's spring creeks originate in valley bottoms and are relatively short in length. Major land use activities in the valleys are agriculturally based, including livestock and crop production. Many of the creeks have been integrated into irrigation and grazing systems with their courses altered, their riparian habitat grazed, and their flows diverted for irrigation or augmented by river water.

The MDFWP Interagency Stream and Lake Data Base and a geothermal site inventory (MBMG 1981) were used to gather initial spring creek location data (Appendix C). Additional information was gathered from fisheries managers and biologists in state and federal agencies and private conservation and consulting groups. Due to budget constraints, the inventory was limited to spring creeks with flows greater than 5 cfs (Appendix D). Smaller creeks were only included if they were locally or regionally important. Creeks where surface flow contributed more than 50% of the creek's annual flow were also not reported.

Spring creek inspections began in May, 1985. The opportunity for public access on a creek usually determined the extent of the inspection. If public access was restricted, the inspection was confined to a road crossing(s) or other public access point. In situations where either landowner permission was obtained or public access was unrestricted, the entire length of

stream or reaches of the stream were walked. The channel inspection included a temperature measurement, channel width and depth measurements, an estimation of flow, a visual substrate composition analysis, and aquatic macrophyte abundance. The riparian zone inventory consisted of determining riparian health, species composition, and percent bank cover. Land use was recorded and the effect of that activity on stream habitat was noted.

Upon the completion of site inspections, compilation of existing biological, chemical, and physical data for each creek occurred. MDFWP regional and state headquarters files were examined for information on spring creeks. Dingell-Johnson progress reports from 1950 to 1987, MDFWP fisherman logs, and the MDFWP Stream and Lake Data Base were reviewed for any available spring creek data. Files from the Water Quality Bureau, the US Geological Service (USGS), and non-profit organizations involved in land conservation programs were investigated. Flow information was collected from USGS files from 1910 to the present. Private individuals were contacted to obtain data on spring creeks on their property. Legal descriptions, channel length, and land ownership were obtained from Bureau of Land Management 1:100 000 maps. Legal descriptions were described by township, range, section, and quarter or quarter-quarter section. Quarter sections were described from A to D with A being the NE 1/4, B being the NW 1/4, C the SW 1/4, and D the SE 1/4. All distance and size measurements were recorded in British Units. Fish species were cited by their common names (Appendix B).

The final spring creek narratives include sections describing general stream information and location, land use and physical measurements, habitat trends and limiting factors, and fisheries and other biological data. The final section, potential value and management recommendations, includes an evaluation of the potential of the creek as a resident fishery or its importance to the drainage. The management recommendations resulted from subjective evaluation and input from MDFWP area fisheries biologists.

A volume of photographs of the inventoried spring creeks is on file at the Fisheries Division office of the MDFWP in Helena, Montana.

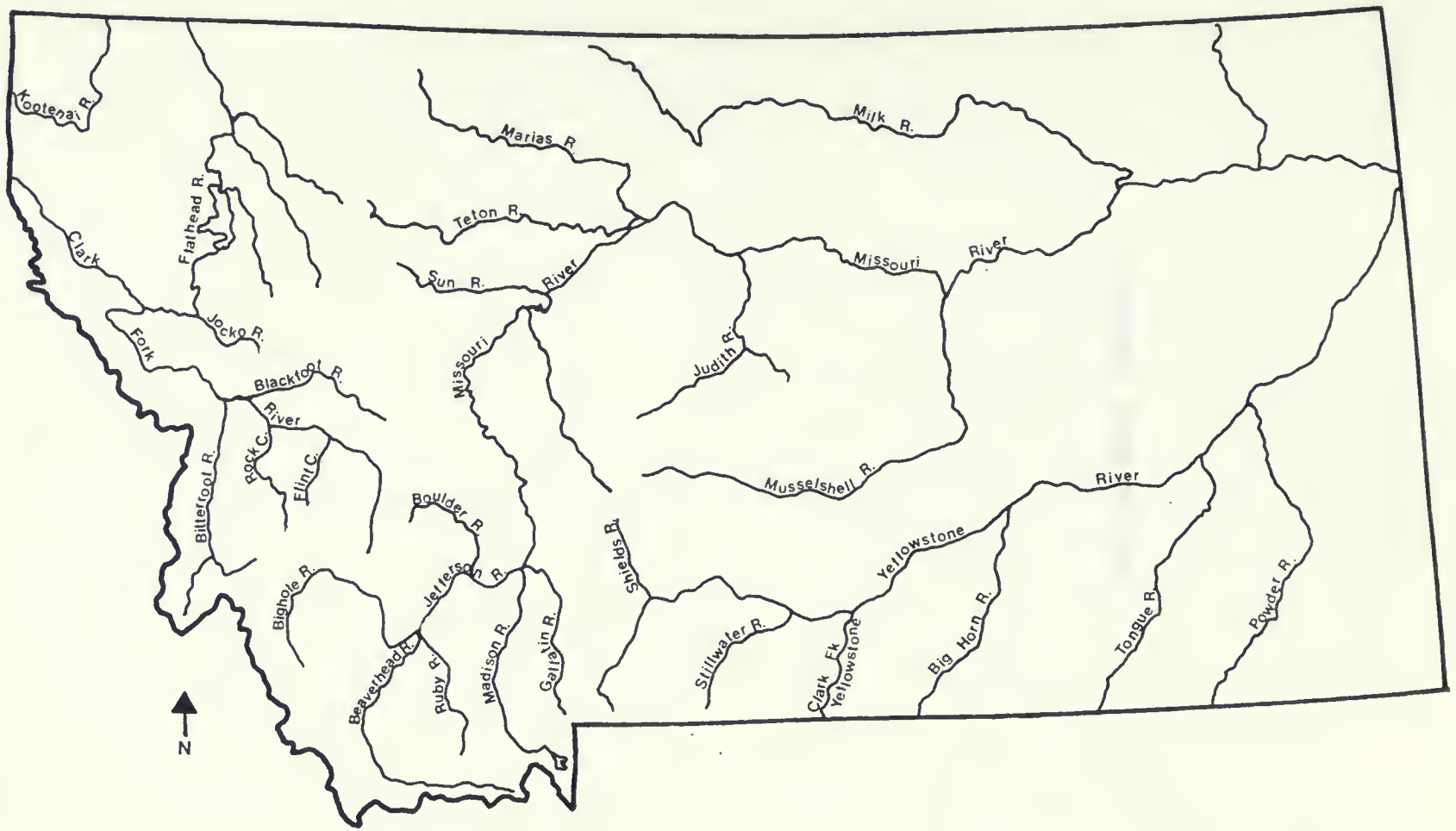


Figure 1. Map of the State of Montana with the major river drainages.

KOOTENAI RIVER DRAINAGE

STANLEY CREEK

Region: 1 Water Code: 11-6480
Legal Description: Origin: T29N, R34W, Section 35BD
Mouth: T29N, R34W, Section 13BA
County: Lincoln

General Description

Stanley Creek flows in a southerly direction for 4.8 miles before entering Lake Creek at river mile 13.8. Lake Creek is a tributary to the Kootenai River entering at mile 187.0. Stanley Creek flows entirely on the Kootenai National Forest. Public access is unrestricted. Two major tributaries are located in the drainage, Thicket Creek at river mile 1.8 and Fairview Creek at river mile 2.7. The springs that feed Stanley Creek are considered to be the underground outlet of Spar Lake, located 1.5 miles above the springs (Domrose 1973). Timber harvest and mining are the major land uses in the drainage. A silver mine was opened in the drainage in 1981 by ASARCO (USFS AND DSL 1978).

Physical and chemical data were collected on Stanley Creek in 1977 prior to the mine opening. The creek ranges in width from 10 to 40 feet with a mean depth of 12 inches. Base flow during 1977 was 33 cfs (USFS and DSL 1978). Surface runoff affects the flows in Stanley Creek on a seasonal basis. A flow of 171 cfs was measured in May, 1977 (USFS AND DSL 1978). Stanley Creek water was soft, alkaline, and calcium-bicarbonate in character, showing low concentrations of dissolved minerals and nutrients (Appendix A). Turbidity and total suspended solids were low, not increasing significantly during runoff. Water temperatures during 1977 ranged from 42 to 64.4^{o} (5.5 to 18^{o}C). The substrate composition was a clean/gravel mixture free of sediment accumulation.

The riparian zone of Stanley Creek is in excellent condition. The canopy species include cedar, willow, and alder. Deeply undercut banks and considerable debris add to instream cover.

Habitat Trend and Limiting Factors

The fisheries habitat in Stanley Creek will remain in a static condition if no major problems occur as a result of timber harvest and mining in the drainage. The groundwater is being monitored to detect quality changes resulting from the mining operation. Limiting factors in the creek are generally natural. The water is cold and relatively infertile flowing in a channel with a fairly steep gradient.

Fisheries

Fish sampling occurred in 1977 to document baseline conditions prior to the mining operation (USFS AND DSL 1978). Brook trout, westslope cutthroat, and cutthroat/rainbow hybrids were the game species surveyed. Slimy sculpin was the only nongame species found. Brook trout were estimated in a 1,000 feet section at 281 individuals with a total biomass of 8.9 pounds (USFS and DSL 1978). Growth was considered slow. Spawning occurs in Stanley Creek from Lake Creek trout.

Potential Value and Management Recommendations

The fisheries potential of Stanley Creek is currently being met. The water is cold and low in dissolved nutrients and the channel gradient is fairly steep. Monitoring in the drainage of the surface and groundwater quality should continue to document changes from the mining operation.

FLATHEAD RIVER DRAINAGE



Figure 2. Flathead drainage map.

FLATHEAD RIVER SPRINGS

Numerous springs enter the Flathead River between Flathead Lake and the mouth of the South Fork Flathead River. Most of the springs were inventoried to determine spawner use by Flathead Lake kokanee salmon. Resident fisheries were not surveyed in most of the springs.

Columbia Falls Slough enters the Flathead River at river mile 144.1 after flowing in a southerly direction for .6 mile. Water from the main stem flood into the slough during spring runoff. Water temperatures in November, 1983 ranged from 43 to 45°F (6.1 to 7.2°C) (John Fraley, pers. comm.). Resident fish populations included brook trout and mountain whitefish.

Taylor Spring Creek flows for 2 miles in a southeasterly direction before entering the river at mile 142.6. Two ponds have been constructed on the channel. Investigation of the creek occurred in July, 1982 when it was being considered as a mitigation spawning channel for kokanee salmon. Flow was measured at 21.3 cfs, water temperature was 55°F (13°C), and dissolved oxygen was 13.3 mg/l (John Fraley, pers. comm.). One landowner owns the entire creek and uses the adjacent land and the spring for cattle and hay production.

Spring Creek flows in a westerly direction for 1.2 miles before entering the river at mile 134.2. The creek is entirely on private property and cattle grazing and hay production are major land uses. Access to the creek is blocked by numerous beaver dams (Mark Gaub, pers. comm.)

Fairview Spring flows for less than .5 mile in a southerly direction before entering the river at mile 132.6. Spring runoff water overflows into the spring's channel. The origin of the spring is located on an island in the river.

Lybeck Spring flows in a southerly direction for less than .5 mile before entering the river at mile 132.0. The creek is affected by the operation of Hungry Horse Dam. Much of the streambed is dry at normal winter flow (Fraley and Graham 1982). The cobble/gravel substrate is generally covered by a layer of fine sediment. A flow of 13 cfs was recorded in November, 1979.

Brenneman's Slough flows in a southeasterly direction for 1.5 miles before entering the river at mile 125.2. The operation of Kerr Dam from April to November backs river water into the slough. Flows were measured on an annual basis and ranged from 7 to 11 cfs (Fraley and Graham 1982). Water temperatures range from 39 to 51°F (4 to 12°C) from April to November. The substrate is a gravel/cobble mixture covered by a layer of fine sediment up to three feet deep. Resident fish species include mountain whitefish and rainbow and cutthroat trout. Cattle grazing and crop production occur in the drainage.

Siderius Slough flows in a southerly direction for less than 2 miles before entering Brenneman's Slough. Westslope cutthroat and brook trout have also been surveyed (DFWP Region 1 files). Fine sediment was measured up to 6 feet deep in 1988 (Bruce May, pers. comm.).

MIDDLE FORK FLATHEAD RIVER SPRINGS

Beaver Creek parallels the Middle Fork for less than 1 mile before entering the river at mile 13.4. One landowner owns the entire stream and public access is restricted. Land use along the creek includes cattle grazing and irrigated hay fields. The channel is used by the Middle Fork during spring runoff. Total length of the creek has been reduced as a result of major channel alterations (Mark Gaub, pers. comm.). Flows ranging from 35 to 42 cfs were measured in 1983 (Fraley 1984). Water temperature ranged from 37 to 45°F (2 to 7°C) from November 1978 to May 1979 (John Fraley, pers. comm.). Residentgame fish species include brook, westslope cutthroat, rainbow, and bull trout.

Pouliott Spring Creek parallels the river for less than one mile before entering Deerlick Creek, a tributary to the Middle Fork. Two landowners own the creek and access is completely restricted. No cattle grazing or irrigation occur in the drainage. Water temperatures ranged from 42 to 44 °F (5 to 6°C) from February to May, 1979 (John Fraley, pers. comm.). Beaver dams are numerous in the lower channel.

EAST SPRING CREEK

Region: 1 Water Code: 07-4280
Legal Description: Origin: T29N, R21W, Section 15
Mouth: T28N, R21W, Section 09B
County: Flathead

General Description

East Spring Creek flows for approximately 6 miles in a southerly direction before entering the Stillwater River at river mile 2.6 near Kalispell. Trumbull Creek is the only tributary in the drainage entering at river mile 3.7. The stream is in private ownership except for a 1.5 mile section located in the Stillwater State Game Preserve. Lands adjacent to the creek are used for residential and agricultural purposes. Flows of 14 to 65 cfs have been measured in the lower creek (Spratt 1986).

In 1986, a committee to rehabilitate East Spring Creek was formed with representatives from the Flathead Conservation District, the Soil Conservation Service, DFWP, local landowners, a hydrologist, and local conservation groups. Enhancement of the instream water quality and fish and wildlife habitat of the creek and to create a brook trout fishery for youthful anglers were the goals of the project (Spratt 1986). The rehabilitation plan developed by the committee received a grant for monies from the State of Montana's Coal Tax Trust Fund in the amount of $75,000. An addition $7,000 was received from the Department of Natural Resources and Conservation.

Prior to the rehabilitation, the habitat of East Spring Creek had deteriorated substantially as a result of agricultural and residential practices. The stream channel had been widened causing decreased depth and slowed water velocities. Variation in water temperature was higher than expected for a spring creek. Extensive sediment had been deposited. Improperly used and sized culverts restricted the natural flow. Riparian habitat had been altered from dense willow and alder to grass and forbs along portionsof the stream not fencedfromlivestockuse.

The East Spring Creek Rehabilitation Project was begun in 1987. The majority of the work was completed in 1988. The creek was rehabilitated from the headwater area to the old Highway 2 bridge. Work included the removal of considerable debris and trash, extensive fencing of the area to eliminate livestock use, narrowing and deepening of the stream channel through extensive dredging and the construction of gabions, modifying outlet structures on irrigation dams to allow upstream fish passage and periodic flushing of sediment and silts, and revegetation of the riparian area using alder plantings (Spratt 1986). Plans to divert river water to moderate temperature fluctuations has been discussed. Concerns over these plans include reducing natural

nutrient concentrations and altering the spring creek nature of the creek. Conservation easements along all modified portions of the stream is an eventual goal of the plan.

Habitat Trend and Limiting Factors

The extensive rehabilitation effort made at East Spring Creek has far advanced its potential for providing trout habitat and restoring its spring creek nature.

Fisheries

Baseline fisheries information was collected in the headwater area and a section approximately 3 miles above the mouth from September 1987 to July 1988 (Will Beattie, pers. comm.). Brook trout in the headwater area ranged in length from 2.5 to 12.8 inches, dominated by 0+ and I+ fish 2.5 to 7 inches in length. In the 150 m section 3 miles above the mouth, the total population was estimated using a two-pass method at 48 ($\pm$ 21) brook trout. Rainbow trout, mountain whitefish, sculpins, and redside shiners were also collected in the lower reach. The greater species diversity in the lower section resulted from higher habitat quality and spring-influenced higher productivity. It was believed the lower section better demonstrated the fish production potential of the creek.

A section 4.5 miles above the mouth was sampled following the rehabilitation work. Only redside shiners were captured. The recent disturbance of the channel and resulting turbidity probably caused resident trout to move from the area (Will Beattie, pers. comm.).

Potential Value and Management Recommendations

Future efforts should include stabilizing stream banks that are now covered with excavated material, adding structure to the stream, and improving bank cover. The narrower, deeper, faster-flowing excavated channel still lacks many essential features of fish habitat. Much of the creek will have to rely on natural processes to add these elements of fish habitat. Habitat and fisheries monitoring should be of central importance to the future of the project.

The cooperative nature of the rehabilitation project on East Spring Creek sets an example that could be applied to many other spring creeks in the state.

MILL CREEK

Region: 1 Water Code: 07-2820
Legal Description: Origin: T28N, R20W, Section 10DD
Mouth: T28N, R20W, Section 27BB
County: Flathead

General Description

Mill Creek flows in a southwesterly direction for 4.1 miles before entering the Flathead River a mile 112.5 near Creston, Montana. Blaine Creek is the only tributary in the drainage, entering at river mile 1.7. The creek originates in Jessup Mill Pond located on USFWS property. The Creston Fish Hatchery is located on this property and diverts approximately 95% of the flow for the hatchery operation. The remainder of the drainage is divided between at least 5 private landowners. Cattle and horse grazing and crop production dominate the other land uses in the drainage. Several residential houses are also located on the banks. Access is restricted throughout the entire length. Hunting rights are leased on the lower 1 mile of stream. Highway 35 crosses Mill Creek near river mile 3.0.

Physical and chemical data have been collected sporadically on Mill Creek. Flows were measured by the USGS in 1960 at several locations. Above and below the hatchery, the flows were measured at 27.6 and 43.7 cfs, respectively. A flow of 32 cfs was measured in October, 1985 below the Highway 35 bridge (Bob Domrose, pers. comm.). Annual water temperatures range from 38 to 52^{o}F (3 to 11^{o}C) with a mean temperature of 46^{o}F (7^{o}C) (Tom Pruitt, pers. comm.). Width ranges from 15 to 30 feet with a mean depth of 18 inches. Pool depths exceed 36 inches in many locations. The stream is characterized by a pool/run sequence with intermittent riffles. The substrate consists of fine sediment covered by aquatic vegetation in much of the channel. The health of the riparian zone varies depending on adjacent land use. The upper section on USFWS property is characterized by a dense cover of ponderosa pine, willows, grasses, and forbs. Sections heavily grazed by cattle are void of woody species and grasses and forbs are the major species in the zone. Horticultural landscaping dominate the riparian zone .5 mile section immediately below the highway. The riparian zone in the lower 3 miles is in fair to good condition. Clumps of willows and alder are located throughout this section.

Habitat Trend and Limiting Factors

The habitat trend on much of Mill Creek is in a deteriorated state except for the property owned by the USFWS. Poor land use practices account for the majority of the habitat deterioration. Depending on individual landowner use of the creek, the habitat varies throughout the stream length. The section below the USFWS

property has been heavily grazed. No woody riparian vegetation is present. Banks are sloughing and raw and the channel has been widened. The section immediately below the highway has been channelized for approximately 200 yards and the banks have been landscaped.

Mill Creek has been chosen by DFWP as an off-site mitigation site to improve fish habitat, enhance fish populations, and provide increased fishing opportunity for bald eagles. The mitigation is to compensate for potential losses in fish production in Hungry Horse Reservoir caused by expansion of the intertie access system to the Southwest which is managed by Bonneville Power Administration.

The initial construction phase on the mitigation project is to occur in 1988-89 with completion in 1991 (May, 1988). The management plan is organized by land ownership and the stream is divided into 10 sections. No action has been recommended on four sections. The plan addresses reducing channel width and deepening channel depth, increasing velocity, providing and/or enhancing spawning habitat, revegetation, livestock damage to the stream bank, needs for stock water facilities, and providing fish passage. Dredging, fencing, gravel placement, stream improvement structures, willow and alder plantings, and a fish barrier to prevent access to the USFWS hatchery above the management area are included as management alternatives in the plan. Beginning in September, 1988, 20,000 westslope cutthroat trout will be planted annually in Mill Creek as part of the mitigation package. Habitat evaluation stations will be established in four sections. Physical and biological data will be collected prior to construction and collected annually at these stations.

Fisheries

Rainbow, brown, and westslope cutthroat trout have been collected in Mill Creek. No population estimates have been calculated. Large numbers of brook trout were caught in the 1960s (DFWP Fisherman Logs).

A 500 foot section downstream from the highway bridge was electrofished in October,1985 (Bob Domrose, pers. comm.). Four rainbow trout and 1 brook trout were captured. Total length ranged from 3.4 to 7.0 inches. Mottled sculpins were also captured. The stream in this area flows through a heavily grazed pasture lacking woody riparian species.

Two section of Mill Creek were sampled with electrofishing gear in October, 1988 (Bruce May, pers. comm.). Low numbers of rainbow and brook trout and slimy sculpins were collected in the upper section (3000 feet in length) above Highway 35. The donwstream section (2000 feet long) located below the highway also had low numbers of rainbow and brook trout. Mountain whitefish, northern squawfish, peamouth chub, and largescale sucker were common. The largest fish caught was an 18.1 inch rainbow trout.

Potential Value and Management Recommendations

The habitat improvement project will greatly enhance the trout potential in Mill Creek. Water quality is excellent, flow and temperature are constant, and in areas where grazing has not occurred, habitat is of high quality.

RONAN SPRING CREEK

Water Code: 07-4300
Legal Description: Origin: T20N, R20W, Section 14DB
Mouth: T21N, R19W, Section 08CA
County: Lake

General Description

Ronan Spring Creek flows in a southeasterly direction for 9 miles before entering Crow Creek at river mile 11.5 below Ronan. Crow Creek is a tributary to the Flathead River, entering at river mile 41.5. The creek originates from a series of springs located in a depression in a hay field on the Confederated Salish-Kootenai Indian Reservation. Most of the creek and its adjacent land has been leased to non-tribal members. The remainder is either privately used by tribal members or open to unrestricted public use by tribal members. Non-tribal members must obtain a tribal recreational permit to fish the creek. Major land uses in the drainage are cattle and crop production. Approximately 1 mile of the creek runs through the town of Ronan and is used as a city park.

Several studies have documented the physical characteristics of Ronan Spring Creek. Width of the channel ranges from 10 to 30 feet with a mean depth of 18 inches. Channel restrictions have formed pools up to 36 inches deep. A USGS gauging station was located on Ronan Spring Creek from 1974 to 1977. Flows ranged from 19.7 to 32.3 cfs with a mean flow of 25.0 cfs. The substrate composition is characterized by a gravel/cobble mixture covered by a heavy accumulation of fine sediment in all areas except below channel constrictions. Aquatic plants are numerous throughout the channel during the summer months.

Water temperatures were measured during 1975 in conjunction with a valley wide study (Morrison and Mailre 1977). Temperatures ranged from 55 to 63^{o}F (12 to 17^{o}C). Specific water quality parameters were measured in 1976 and 1977 above and below the town of Ronan (Morrison and Mailre 1977). Levels of constituents were generally comparable except for total coliform. These levels were elevated well above state water quality standards below the town of Ronan.

The riparian zone of Ronan Spring Creek consists of grasses and forbs along much of the creek. Where woody species are present, species include willow, cottonwood, elderberry, water birch, sedges, rushes, and grasses.

Habitat Trend and Limiting Factors

The fisheries habitat of Ronan Spring Creek is deteriorating. Cattle grazing within the riparian zone has caused

bank sloughing, a widening of the channel, sediment deposition, and a loss of woody species. The city of Ronan's urban storm system discharges into the creek. The banks are heavily groomed through the city park.

Fisheries

Fisheries surveys have been conducted on Ronan Spring Creek since 1965 (Domrose 1971, Peterson 1976, USFWS 1979, and Randall 1980). Brook and rainbow trout and mountain whitefish have been inventoried. Nongame species have included longnose dace, largescale and longnose sucker, and redside shiner.

Population estimates were calculated on three sections of the creek in 1982 (Jim Darling, pers. comm.). The variation in populations were related to habitat differences resulting from land use practices (Jim Darling, pers. comm.). In a section 1.5 miles above the town of Ronan, 1421 brook trout and 259 rainbow trout were estimated in a 1,000 feet section. Brook and rainbow trout ranged from 3.9 to 11.6 inches. This section of stream was fenced and no grazing was allowed along the banks. An estimate .5 miles above Ronan calculated 504 brook trout and 62 rainbow trout in a 1,000 feet section. Total length ranged from 4.1 to 10.8 inches and 5.7 to 13.7 inches for brook and rainbow trout, respectively. This section was not fenced and seasonal grazing did occur along the stream banks. A 1,000 feet section directly above the town of Ronan was the third section electrofished. The trout population was estimated at 211 brook trout ranging from 4.5 to 11.3 inches and 23 rainbow trout ranging in length from 6.0 to 13.8 inches. This section was not fenced and banks were open. A reach near the mouth was electrofished in the summer of 1985 (Ginger Thomas, pers. comm.). Redside shiner, longnose dace and longnose and common sucker were the only species collected in the 500 feet section. No game species were collected in the section.

Potential Value and Management Recommendations

Fencing of Ronan Spring Creek would greatly enhance the fishery habitat evidenced by higher numbers of trout in fenced versus non-fenced stream sections. Drop structures throughout the channel would create clean substrate, increasing spawning gravels. The section of creek running through the town of Ronan should be returned to a more natural state. Recent discussions by Tribal natural resource staff have centered around the protection of the spring area. No plans have been formulated at this time.

SCHALL (VALLEY) SPRING CREEK

Water Code: 07-4840
Legal Description: Origin: T17N, R20W, Section 35AD
Mouth: T17N, R20W, Section 17AB
County: Lake

General Description

Schall Spring Creek flows for approximately 5 miles in an easterly direction before entering the Jocko River at mile 11.5. Schall Spring Creek arises from a series of springs in a low wooded area in the Jocko Valley. LaMoose Creek is the only tributary in the drainage, entering at river mile 3.2. The flow of LaMoose Creek is relatively small and does not affect Schall Creek flow on an annual basis. The creek is located entirely on the Confederated Salish-Kootenai Indian Reservation. The majority of the creek (84.4%) is leased by non-tribal members. The remainder is used by tribal members for private activities. Six landowners in the drainage produce cattle and crops. The channel is used to transport irrigation water. Access is restricted but granted by permission by some of the landowners.

Physical and chemical data have been collected sporadically on Schall Spring Creek. Channel width ranges from 4 to 15 feet with a mean depth of 10 inches. Flows measured by the USGS ranged from 11.1 to 16.8 cfs. Flows up to 41.5 cfs have been recorded during the irrigation season (Ginger Thomas, pers. comm.). Velocity is slow throughout except for a short channelized section paralleling the highway and railroad. Stream morphology is characterized by a riffle/run sequence meandering across the Jocko Valley. Pools are infrequent. The substrate composition is a gravel/cobble mixture covered by fine sediment throughout much of the channel. Where gravels are clean, the substrate is armored. Water temperature at the time of the site visit in June, 1985 was 53°F (11.7°C).

The riparian zone is patchy throughout the channel depending on land use. Willow cover increases below Highway 93 although much is in a decadent state. Above the highway, woody plants are less common and grasses and forbs are the dominant species.

Habitat Trend and Limiting Factors

The fisheries habitat in Schall Spring Creek is in a deteriorated condition throughout much of the channel. Cattle grazing has reduced woody bank cover, widened and shallowed the channel, and reduced instream cover. Fines have accumulated in the runs and pools. Banks are sloughing in the lower section below the highway. The channel is braided at the mouth to the Jocko River. Irrigation return and transport cause turbid conditions during the irrigation season.

Fisheries

Numerous electrofishing surveys have been conducted on Schall Spring Creek since 1969 (Domrose 1971, Peterson 1976, USFWS 1979, Randall 1980, and Ginger Thomas, pers. comm.). Game species surveyed include rainbow, brook and brown trout and mountain whitefish. Nongame species surveyed include mottled sculpin and sucker species. The USFWS have been responsible for the management of Schall Spring Creek. Stocking of catchable rainbow trout occurred until 1982. Spawning mountain whitefish migrating from the Jocko River have been documented using the channel (USFWS 1979).

A population estimate was conducted near the mouth of Schall Spring Creek in September, 1985 (Ginger Thomas, pers. comm.). The estimate indicated brown trout were the dominant game fish, followed by mountain whitefish, and rainbow trout. Although an estimate was obtained, confidence intervals were larger than the point estimates and therefore, are not included in this discussion. Mean length of brown trout, whitefish and rainbow trout were 4.9 inches, 6.8 inches and 4.7 inches, respectively.

Potential Value and Management Recommendations

Agricultural practices on Schall Spring Creek have severely degraded the fisheries habitat. Fencing and establishing stock watering gaps could greatly enhance the creek's trout habitat. Alternative routes for the transportation of irrigation water could reduce turbidity, sediment deposition, and channel armoring.



CLARK FORK RIVER DRAINAGE


Little Blackfoot S.C.
BLACKFOOT RIVER
Avon
LITTLE
NEVADA CREEK
Warm Springs Cr.
Garrison
Rock Cr.
Kliendschmidt Cr.
Lost Cr.
Nevada S.C.
N. FK. BLACKFOOT R.
Ovando
FLINT CREEK
Stuart Mill Cr.
GEORGETOWN LAKE
BLACKFOOT RIVER
CLARK FORK RIVER
Spring Cr.
ROCK CREEK
N

LITTLE BLACKFOOT SPRING CREEK

Region: 2 Water Code: 06-3600
Legal Description: Origin: T10N, R07W, Section 13DC
Mouth: T10N, R07W, Section 33BC
County: Powell

General Description

Little Blackfoot Spring Creek flows in a southwesterly direction for 3 miles before entering the Little Blackfoot River between the towns of Avon and Elliston. The creek is owned by one landowner and access is restricted. Land use along the creek includes cattle grazing and an occasional hay field.

Physical data on the creek were limited to observations made at the time of the site visit in 1985. The channel was 15 to 30 feet wide with a mean depth of 8 inches. Stream flow was estimated at 6 to 10 cfs. Water temperature was 58°F (14°C). Substrate composition consisted of a clean cobble and gravel substrate covered by clumps of watercress, other aquatic macrophytes, and benthic algae. The riparian zone was in poor condition in the upper section, severely degraded by cattle grazing. Species composition in the riparian zone included willow, grasses, and forbs. There were no woody plants on the left bank and less than 30% of the right bank was covered. Many of these plants were decadent and provide no overhanging cover. The upper 2.5 miles of creek flowed in a run/riffle sequence. The lower .5 miles of creek was inundated by beaver dams and riparian health increases. Velocity was greatly reduced and fines have accumulated in the channel.

Habitat Trend and Limiting Factors

The fisheries habitat in Little Blackfoot Spring Creek is in a deteriorated condition. Cattle grazing has destroyed the riparian zone, widened the channel, and caused severe bank slumping. Channel width has been artificially increased to 15 to 30 feet. Depth is greatly reduced and instream cover is lacking. Beaver dams on the lower channel have altered the riffle/run nature of the stream and blocked 90% of the channel in some areas.

Fisheries

No fisheries data have been collected on Little Blackfoot Spring Creek. Migration of spawning trout from the Little Blackfoot would be probably restricted by the beaver dams in the lower channel.

Potential Value and Management Recommendations

A fisheries and habitat survey should be conducted on Little Blackfoot Spring Creek to document existing fish populations and conditions. Fencing of the creek from cattle grazing would greatly enhance the trout habitat. The potential exists for a high quality resident trout population if the stream could be narrowed and instream and bank cover allowed to develop. Removal of the beaver dams on the lower channel could improve access of spawninng trout from the Little Blackfoot River.

WARM SPRINGS CREEK

Region: 2 Water Code:06-6878
Legal Description: Origin: T10N, R10W, Section 25AA
Mouth: T09N, R10W, Section 15BB
County: Powell

General Description

Warm Springs Creek flows in a southeasterly direction for 9 miles before entering the Clark Fork River at river mile 440.5 near Garrison. There is one tributary in the drainage located at river mile 4.4. A 150 foot falls is located at mile 6.0. Numerous spring seeps are located in the falls area. Land ownership in the drainage includes 5% by the Bureau of Land Management, 5% by the State of Montana, and the remaining 90% in private landholdings. Land use activities in the drainage include grazing, hay production, mining, and recreation. A phosphate mine owned by the Comico Company of Canada is located in the upper drainage. Access is restricted in the mine area and is granted by permission from most of the landowners on the lower creek.

Physical and habitat data are limited on Warm Springs Creek. Channel width ranges from 6 to 15 feet with a mean depth of 12 inches. Depth in pools exceed 2 feet. A flow of 10.2 cfs was measured near the mouth by the USGS in 1972. A temperature of 67°F (19°C) was measured at the time of the site visit in October, 1985. The substrate composition in the stream's upper 5 miles is a clean gravel and cobble mixture covered by thick beds of watercress. Riparian health is excellent and species composition includes conifers, willow, alder, grasses, and forbs. The lower 2 miles of channel have been abused severely by cattle grazing. The substrate has been covered by a layer of fine sediment. Riparian zone health is poor and only 30% of the banks are covered by woody species. Beaver dams have created numerous pools in the lower .5 mile of stream.

Habitat Trend and Limiting Factors

The lower 2 miles of Warm Springs Creek is in a deteriorated condition as a result of agricultural practices. The channel is used extensively for stock watering and much of the woody riparian zone has been removed by grazing. Bank sloughing and channel instability is apparent throughout the lower section. The stream flows through a small feedlot located approximately 2 miles from the mouth. Beaver dams have restricted spawner access from the Clark Fork River.

Potential Value and Management Recommendations

Use of Stuart Mill Creek as a spawning area could be greatly expanded if the dam and waterwheel were removed. Current kokanee management in Georgetown Lake, however, is concentrating on reducing the number of kokanee to increase size. An instream flow reservation should be filed on Stuart Mill Creek to protect this important spawning tributary to Georgetown Lake.

ROCK CREEK SPRING CREEK

Region: 2 Water Code: NA
Legal Description: Origin: T10N, R15W, Section 6AA
Mouth: T11N, R17W, Section 36A
County: Granite

General Description

Rock Creek Spring Creek flows in a southwesterly direction for approximately 4 miles before joining Rock Creek 2 miles above its mouth. The spring creek parallels Rock Creek for the majority of its length, turning to the west under the Rock Creek road for its last 1/4 mile. Flow was estimated at 4-5 cfs in a channel 15-20 feet wide with a mean depth of 10 inches (Gary Micheals, pers. comm.). Woody riparian vegetation is limited to the lower 100 yards. The remaining stream bank vegetation is limited to grasses and forbs. Substrate composition is limited to gravel and cobble covered by a heavy layer of fine sediment and scattered macrophytes. The only clean substrate was located below the Rock Creek Road at the mouth of the culvert.

Cattle graze extensively on both banks and is currently the major land use. The creek was diverted in the late 1970s through a series of private hatchery raceways for the production of rainbow trout. Although the raceways are still apparent, commercial trout production no longer occurs. In recent years, the creek was planted by the landowner with stock reared in the raceways. A fee of $10 per pound was charged for angling. Rainbow up to 10 pounds were the primary target.

The fisheries habitat in Rock Creek Spring Creek is in a deteriorated condition. Cattle grazing has removed much of the woody riparian zone. Hatchery raceways have made the creek aesthetically unpleasing. Channel width has been artificially increased to 30 feet due to bank trampling. Depth is greatly reduced and instream cover is lacking. Due to the position of the culvert at the mouth, a deep eddy is formed in Rock Creek and spawner access is questionable.

No fisheries data have been collected on Rock Creek Spring Creek. A survey is scheduled for the fall of 1989.

NEVADA SPRING CREEK

Region: 2 Water Code: 04-3910
Legal Description: Origin: T13N, R11W, Section 11DC
Mouth: T13N, R11W, Section 9CC
County: Powell

General Description

Nevada Spring Creek meanders across the Nevada Creek valley for approximately 3 miles before entering the creek at mile 11.0 near the town of Helmville. There are two landowners on the spring creek. The upper landowner owns the majority of the creek. Access is restricted and limited to family and friends. Cattle grazing and hay production are the major land activites in the drainage. Nevada Spring Creek receives irrigation return and is part of an irrigation system. Its entire length is used for stock water and grazing. The springs flows through a feedlot directly below their origin.

A limited amount of physical and chemical data have been collected on Nevada Spring Creek. The channel is 8 to 25 feet wide with a mean depth of 12 inches. Depth in pools range up to 4 feet. The flow was estimated at 10 to 12 cfs at the time of the site visit in October, 1985. Stream morphology is restricted to slow moving runs with an occasional riffle and pool. The gravel and cobble substrate has been covered by a thick layer of fine sediment. The riparian zone consists of grasses and forbs. All woody species have been removed by cattle grazing. Severe bank sloughing has occurred throughout the channel. Most banks are raw and exposed.

An electrofishing survey on Nevada Spring Creek was conducted during the summer of 1984 (Wayne Hadley, pers. comm.). Because of equipment difficulties and depth of the pools, the survey could not be completed. Several sucker species and redside shiners were collected.

MDFWP personnel and the Montana Land Reliance initiated discussions with the landowner concerning rehabilitating the creek and gaining a conservation easement. The project was not pursued due to the extensive rehabilitation needs of the channel and its cost. A complete rehabilitation plan needs to be developed for the creek including fencing, placing stream structures to create habitat diversity, and planting willows and other woody species to reestablish the riparian zone.

NORTH FORK BLACKFOOT SPRING CREEK COMPLEX

Region: 2 County: Powell

ROCK CREEK
Water Code: 04-4500
Legal Description: Origin: T15N, R11W, Section 26DD
Mouth: T14N, R11W, Section 06AD

KLIENDSCHMIDT CREEK
Water Code: 04-3040
Legal Description: Origin: T14N, R11W, Section 03BD
Mouth: T14N, R11W, Section 07AC

LOST CREEK
Water Code: 04-3280
Legal Description: Origin: T15N, R11W, Section 33BD
Mouth: T15N, R11W, Section 32CB

General Description

Three spring creeks flow into the North Fork of the Blackfoot River between river miles 9.9 and 11.0 near the town of Ovando. Kliendschmidt Spring Creek converges with Rock Creek 300 yards above its confluence with the North Fork. Both streams are approximately 3 miles in length. Lost Creek flows for approximately 1.5 miles before entering the North Fork at river mile 11.0. One landowner owns the entire lengths of Lost and Rock Creeks, including their spring origins. Three landowners own Kliendschmidt Creek, two owning the majority of the creek. Access to all three streams is acquired by permission from the landowners. Land uses in the three drainages include cattle grazing and hay production. Water is diverted for irrigation from all the creeks. The majority of Rock Creek was diverted for commercial trout production from 1977 to 1982. Ten raceways were constructed to raise 200,000 12-14 inch rainbow trout on an annual basis.

Physical and chemical data on the North Fork Blackfoot spring creeks are generally limited to observations. Stream morphology in these three creeks is similar, restricted to runs and riffles. Width of each creek varies from 6 to 20 feet with mean depths of 6 to 8 inches. Water temperatures were measured at 58°F (14°C) in each of the creeks at the time of the site visit in July, 1985. Kliendschmidt and Lost creeks flows have been estimated at 15 to 17 cfs and 10 cfs, respectively. A stream flow of 22.0 cfs was measured on Rock Creek at the time of the construction of the hatchery.

The substrate in Rock and Lost creeks is a gravel and cobble mixture free of fine sediment accumulation. Kliendschmidt Creek's velocity is slower, creating more runs and accumulation of fines is apparent throughout most of the upper channel. Velocity

increases in the lower .5 mile and the gravel/cobble substrate is exposed.

Grasses and forbs are the dominant riparian species on all three creeks. Woody species are lacking in the riparian zone of Lost and Rock creeks. Only the lower .5 mile of Kliendschmidt Creek containing alder, willow, lodgepole pine and grasses, and forbs.

Habitat Trend and Limiting Factors

The fisheries habitat of the North Fork Blackfoot Spring creeks has deteriorated substantially from agricultural practices. Woody riparian species are completely lacking. The channels have been widened and depths reduced. Banks are raw and slumping throughout. Irrigation withdrawls dewater all three streams during the summer months.

Fisheries

Rock Creek below the convergence with Kliendschmidt Creek was snorkeled during September, 1985 by the MDFWP Region 2 Staff. Brown trout ranging in length from 15 to 24 inches and rainbow trout ranging in length from 14 to 18 inches were observed in the large pool formed directly below the Hyway 200 bridge. These fish were felt to be residents of the North Fork Blackfoot River. The lower 200 yards of Kliendschmidt Creek were snorkeled at the same time and no trout were observed in this section. No fisheries data have been collected on Lost Creek.

Potential Value and Management Recommendations

Considerable fisheries habitat improvement would occur on Kliendschmidt and Rock creeks if cattle were fenced from the stream banks. At this time, lack of bank and instream cover prevents these spring creeks from meeting their fisheries potential. Depth is lacking and essentially no riparian zone is present. Both of these streams have substantial flows and could become productive bodies of water. Lost Creek could also be improved significantly with fencing but should be given a lower priority than Rock or Kliendschmidt creeks.

MITCHELL SLOUGH COMPLEX

Region: 2 Water Code: NA
Legal Description: Origin: T08N, R20W, Section
Mouth: T08N, R20W, Section
County: Ravalli

General Description

The channels of Mitchell Slough are a series of old river channels fed by springs and supplemented by Bitterroot River water. The channel begins six miles south of its mouth above Tucker Crossing, located between the towns of Corvallis and Victor. Bitterroot River water is diverted into an old river channel through a headgate owned and operated by the Union Ditch Irrigation System. The channel begins picking up spring water below Victor Crossing from numerous spring seeps and remains in a single channel until Bell Crossing, two miles south of the town of Stevensville. Between the main headgate on the river and Bell Crossing, the water in the Slough branches off and passes through a number of irrigation ditches and smaller headgates, providing crop irrigation and livestock water for nearby landowners. Due to frequent irrigation return, flow in the channel remains fairly stable. Below Bell Crossing, the Slough branches into two large spring-fed creeks, and begins branching and meandering into old river channels across the floodplain.

The spring creek channels below Bell Crossing are located on a ranch owned by Ken Siebel. The Siebel Ranch borders the Bitterroot River for over two miles. The ranch was historically used for agricultural crops production, primarily grass and alfalfa hay, and for cattle grazing. Overgrazing and other agricultural practices have impacted the riparian areas, bank stabilization and stream morphology. Since 1981, there has been no grazing on the ranch and an intense rehabilitation project by a private consulting firm has occurred on the spring channels. Conservation easements are currently held on the Siebel Ranch by the Nature Conservancy and the Land Reliance.

The west branch of Mitchell Slough on Siebel's property has the least spring flow, is 30 to 40 feet wide, and the habitat is pools and runs. The channel is approximately 2.5 miles long with a riparian zone of willows and grasses. The substrate is boulder, gravel, and fines covered by abundant aquatic vegetation. The stream banks were grazed heavily in the past but no grazing is occurring today.

The east channel branches on the Siebel's property, forming two channels which create the east and mid branches. The east branch has a lower natural gradient, with stream morphology of 60% run, 30% pool, and 10% riffles. Silt and heavy macrophytic growth characterize the substrate. Clean gravels are located only in the riffle areas. The riparian zone is generally grasses and forbs

with a few scattered cottonwoods. Overgrazing on the east branch had widened the natural channel and reduced the depth. In 1981, the cattle were removed from the area and a dramatic change in the stream channel has resulted. The channel has been narrowed by extensive maps of watercress and a naturally deepening of the channel has occurred. Willows have been planted along the banks and cottonwood have been placed in the stream as artificial stream structures.

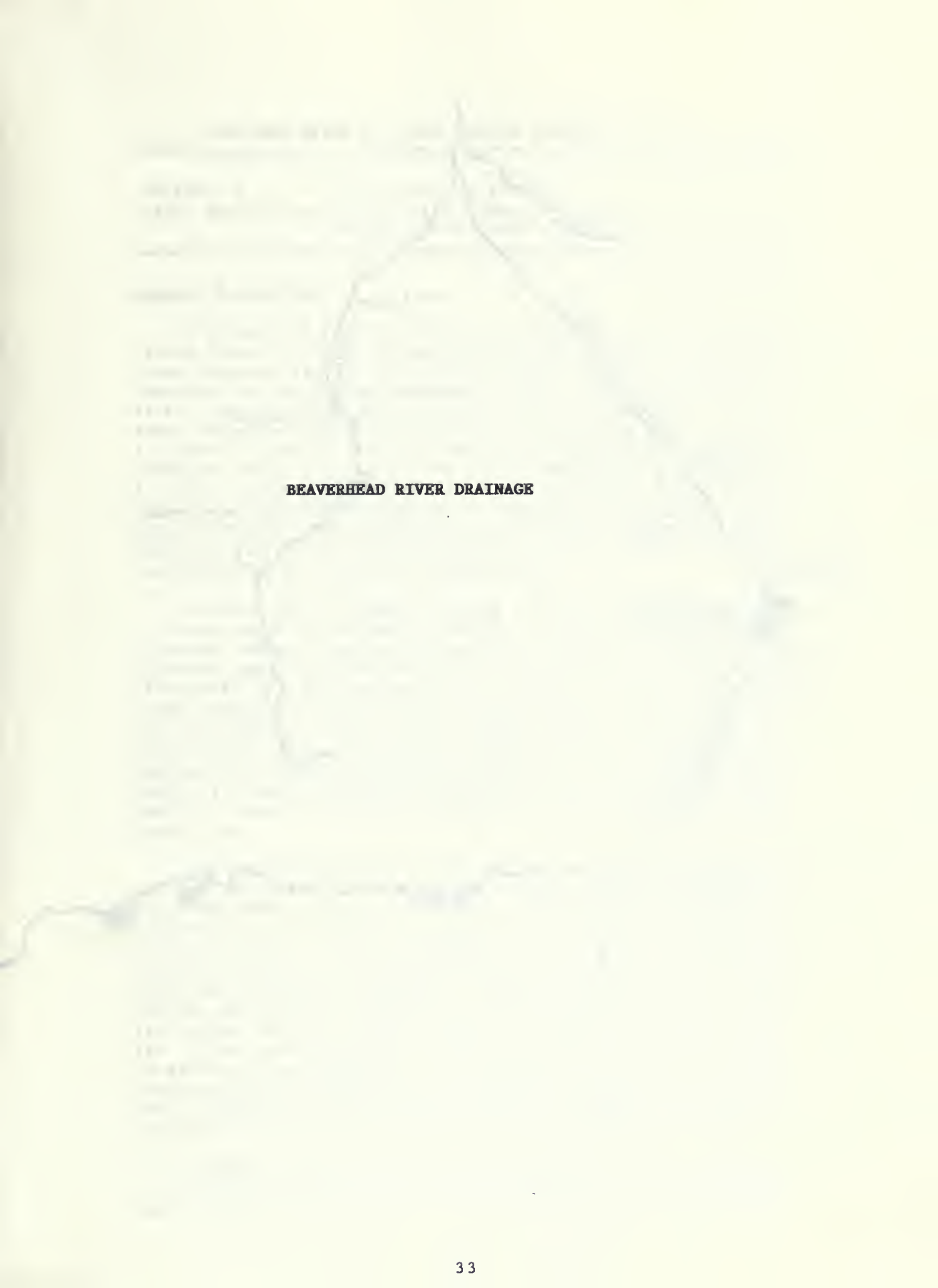
The mid branch of Mitchell Slough has the best riparian habitat of the three branches, characterized by willows and cottonwood groves. The substrate is 90% sediment and 10% cobble and gravel. The improvement plans for this branch include putting in a headgate to flush out the sediment. In the lower section, the stream has been dredged to clean out the accumulated sediment.

Habitat Trends and Limiting Factors

The fisheries habitat on all branches of Mitchell Slough is improving as a result of changes in land use and habitat improvement. Protection of the riparian zone and the spring creek channels is a management priority of the ranch.

Fisheries

Fisheries data have been collected on the branches of Mitchell Slough in 1980 and 1983. Low numbers of trout were recorded in 1980 from a section of the east branch before it branches into the two channels. The majority of the fish were rainbow trout. Brown trout made up 30% of the trout population. The west branch was electrofished three times in the 1980s. The fisheries was predominantly brown and rainbow trout. A redd count was done in the upper section where the best spawning gravels were located. The fishery of the east branch was 60% brown trout and 40% rainbow trout.



BEAVERHEAD RIVER DRAINAGE


Lott's S.C.
BIG HOLE R.
BEAVERHEAD RIVER
Silver Springs
RUBY RIVER
Dillon
Ruby Reservoir
Poindexter Slough
Lovell's Lake
Brown's Spring
Warm Springs Cr.
McMenomey Springs
CLARK CANYON RESERVOIR
Clark Canyon Springs
RED ROCK R.
Big Sheep Cr.
N

RED ROCK RIVER AND CLARK CANYON RESERVOIR SPRINGS

Region: 3 Water Code: 01-1325
Legal Description: Origin: T10S, R10W, Section 29
Mouth: T10S, R10W, Section 29

General Description

Two springs flowing in a northerly direction enter Clark Canyon Reservoir near the mouth of the Red Rock River. Two of these springs parallel the access road at the north end of the reservoir and run for approximately .5 mile when the reservoir is at full pool. These springs each flow an estimated 3 to 5 cfs. Water temperature was 52°F (11°C) at the time of the site visit in August, 1985. The two channels are fairly similar in structure, ranging in width from 5 to 20 feet with a mean depth of 8 inches. Stream morphology is characterized by a riffle/ run sequence. Substrate composition consists of a cobble/gravel mixture with fines accumulating in slower areas. Clumps of aquatic macrophytes provide the only instream cover. Forbs and grasses contribute the majority of the bank cover.

A third spring channel flowing into Clark Canyon Reservoir is located west of the Red Rock River. It flows for approximately 1.5 miles before entering the reservoir. The channel appears to be either manmade or extensively altered. The source is a series of springs in a marshy area. Flow was estimated at 3 to 5 cfs. Water temperature at the time of the site visit in August, 1985 was 54°F (12°C). Width of the channel ranged from 3 to 10 feet with a mean depth of 8 inches. Substrate was a cobble/gravel mixture with fines covering over 80% of the bottom. Riparian health was excellent with 60% of bank cover composed of woody species. Grasses and forbs comprised the remaining riparian vegetation.

No fisheries data have been collected on any of the springs flowing into Clark Canyon Reservoir. Spawning by reservoir brown trout has been observed but unquantified. These springs were investigated for their potential as spawning channels for reservoir trout. With a change in the DFWP rainbow stocking program to a strain capable of spawning in the wild, additional spawning area may be necessary. Water quality is excellent in all the spring channels and flows are relatively constant. Major limitations in their present condition are public accessibility, lack of instream and overhead cover, and lack of adequate velocity to maintain clean substrate. With channel improvement structures increasing the gradient, gravel placement, and construction of cover structures, these three channels could provide extensive and high quality spawning habitat for Clark Canyon Reservoir trout.

Several major springs enter the Red Rock River approximately 3 miles above Clark Canyon Reservoir near the town of Red Rock. These springs were discovered during a flight documenting drought

conditions in the summer of 1988 (Dick Oswald, pers. comm.). Flow in the Red Rock River above these springs was essentially nonexistent. Below these springs, the flow was estimated at 150 cfs. Further fisheries investigations need to be conducted to document spawning use. Negotiations to purchase the ranch where these springs originate is being conducted between the landowner and the Water Heritage Trust, a non-profit organization concerned with maintenance of instream flows.

GORDON SPRINGS

Region: 3 Water Code: 01-3070
Legal Description: Origin: T09S, R10W, Section 30BA
Mouth: T09S, R10W, Section 32CA
County: Beaverhead

General Description

A site visit to Gordon Springs has not occurred by the author. Its existence was learned of through USGS flow records in October, 1985. The DFWP fisheries biologist in Dillon visited the site in December, 1985 and provided information on the spring and photographs.

Gordon Springs flow in a southeasterly direction for approximately 2 miles before entering the Beaverhead River approximately .5 mile below Clark Canyon Dam. Land ownership is private and major land use is agriculturally based. Flows were measured by the USGS during the period of 1964 to 1976. Flow ranged from 16.2 to 35.7 cfs. Water temperatures were recorded during 1966 and 1967 (Richard Kennedy, pers. comm.). Temperatures were constant at 56^{o} ($13^{o}C$). Brown and rainbow trout have been observed spawning in the Beaverhead River below the mouth of the springs (Dick Oswald, pers. comm.). Spawning in the spring channel occurs earlier in the spring then main stem spawning and may increase survival of eggs and fry.

A fisheries and habitat survey should be conducted on Gordon Springs to document existing conditions and spawner use. An instream flow reservation should be filed on the springs.

McMENOMEY SPRINGS

Region: 3 Water Code: 01-4770
Legal Description: Origin: T09S, R10W, Section 29A
Mouth: Same as origin
County: Beaverhead

General Description

McMenomey Springs are located approximately 1 mile below the Clark Canyon Dam. Flow is in a northeasterly direction for less than one mile before entering the Beaverhead River. The springs are located on private property and access is restricted. There are two major springs with numerous smaller springs emerging along the base of the cliffs.

Flow, temperature, and chemical data were collected by the USGS and the BOR in the mid 60s prior to the construction of Clark Canyon Dam. From February to August, 1965, flows varied from 19.4 to 24.9 cfs. Water temperatures were measured from 1965 to 1967 (Richard Kennedy, pers. comm.). Temperatures ranged from 66 to 70°F (19 to 21°C). Water chemistry data were collected in 1981 and exhibited high quality and fertility (Montana Bureau Mines and Geology 1981).

The springs run in poorly defined channels except for the lower .25 mile. The flow is restricted by a weir at the mouth forming a pool. The lower channel is characterized by depths up to 12 inches and a channel width of 4 to 10 feet. Dense mats of watercress are abundant throughout the channel. The patchy riparian zone consists of willow, alder, grasses, and forbs. The west side channel of the Beaverhead River receives the majority of its flow from the springs. This channel is used extensively by spawning rainbow and brown trout (Dick Oswald, pers. comm.). Spawning occurs earlier in this channel as a result of the higher water temperature of the springs. No resident fisheries data have been collected on the springs.

POINDEXTER SLOUGH

Region: 3 Water Code: 01-9320
Legal Description: Origin: T08S, R09W, Section 15 AB
Mouth: T07S, R09W, Section 26 BC
County: Beaverhead

General Description

Poindexter Slough flows in a northwesterly direction for 4.2 miles before entering the Beaverhead River south of the town of Dillon, Montana. In 1980, with the help of the Nature Conservancy, the DFWP purchased a 440 acre cattle ranch in the Beaverhead floodplain that included the lower 2 miles of Poindexter Slough. An additional land trade was made in 1981 which included another .5 mile of the spring creek. The area has been minimally developed by the Department to allow for parking. The Department's management plan for the lands are to provide and protect the spring creek fishery, manage for waterfowl and upland game birds, and manage the area for dispersed walk-in recreational use.

The remainder of the slough is owned by private individuals. The landowner immediately upstream from the state property manages the property for its fisheries values. The two larger springs that contribute to Poindexter Slough are located on this property. Cattle graze in the headwater area. Access is restricted on these properties.

The springs flow approximately 30 cfs but flows up to 100 cfs are not uncommon during the irrigation season (Peterson 1973). A headgate was constructed on Poindexter in the 1930s to allow Beaverhead River water to flow into the slough during irrigation season (Jerry Wells, pers. comm.). The Dillon Canal Company holds the majority of the water rights on Poindexter Slough. The DFWP acquired three irrigation claims with the land sale. In addition to irrigation claims on the springs, the DFWP also owns 6 cfs of Beaverhead River water that can be diverted into Poindexter Slough.

Channel and bank physical condition and characteristics vary along the length of the slough. Channel width ranges from 10 to 40 feet with a mean width of 33 feet (Elser and Wipperman 1971). Deep pools up to 4 feet are common along its course. The remainder of the channel is characterized by riffles and runs with a gravel/cobble substrate. Over 60% of the substrate is covered by fine silts and clumps of aquatic macrophytes. The riparian zone continues to improve on the lower state owned portion with a species composition of willow, alder, grasses, rose, and forbs. Overhanging cover and undercut banks line the stream course.

Habitat Trend and Limiting Factors

The habitat of Poindexter Slough continues to improve due to the changes in land ownership and use. Several problems are still occurring in the drainage. Grazing continues to occur in the headwater area creating excess sediment production. Deposition occurs throughout the channel. An increase in sprinkler irrigation instead of subirrigation may be decreasing the groundwater flow to the slough. The major limiting factor to the slough results from its use as an irrigation canal. The effects of shuttling Beaverhead River water through the slough has had an undocumented effect on fish population dynamics.

Fisheries

The sport fishery of Poindexter Slough consists of brown, rainbow, and brook trout and mountain whitefish. Nongame species surveyed in the Slough include longnose, common, and mountain sucker; longnose dace; and mottled sculpin. The extent of spawning trout use from the Beaverhead River has not documented.

Population estimates using a mark and recapture technique have been conducted on the slough frequently since 1969 (Wipperman and Elser 1971, Peterson 1973, Wells 1980, and Dick Oswald pers. comm.). Numbers of brown and rainbow trout have fluctuated during this time period, generally in the younger age classes (Table 1). Beaverhead River spawner use may explain this variation. A slow rebuilding of the rainbow trout population appears in the 1984 estimate.

Table 1. Population estimates of brown and rainbow trout in Poindexter Slough in 1967, 1981 and 1984. For comparative purposes all estimates have been converted to 1,000 ft sections (Wipperman and Elser 1971 and Dick Oswald, pers. comm.) .

Year	Species	Length Groups		
		6-10.4"	>10.5"	Total
1971	Brown trout	152	120	272
	Rainbow trout	124	59	183
1981		6.5-8.9"	>9.0	Total
	Brown trout	42	283	325
	Rainbow trout	37	37	74
1984	Brown trout	5.0-18.7"		672
	Rainbow trout	12.0-19.1"		32

Potential Value and Management Recommendations

Every effort should be made to maintain, enhance, and improve the fishery and habitat of the only publicly owned spring creek in Montana. Fencing cattle from the headwater area to decrease sediment production should occur. Purchasing or leasing water rights should be a top priority on Poindexter Slough. The effect of Beaverhead River water on the Poindexter Slough trout population should be investigated.

SILVER SPRINGS

Region: 3 Water Code: 01-6930
Legal Description: Origin: T05S, R05W, Section 14CC
Mouth: T05S, R05W, Section 14BD
County: Madison

General Description

Silver Springs meanders across the Ruby Valley in a easterly direction for less than one mile before entering the Ruby River at mile 22.6 near the town of Sheridan, Montana. Two ranches own the springs and its channel. The springs and the adjacent land are used for stock water, cattle grazing, irrigation, and as a commercial trout hatchery. The source is a large spring bubbling out of the ground at the base of a small limestone cliff.

Flows were measured near the mouth by the USGS in the 1940s. Flows ranged from 19.1 to 29.8 cfs on two dates in August. Irrigation withdrawl may have caused these fluctuations. The flow at the time of the site visit in August, 1985 was estimated at 25 to 30 cfs. There is a large diversion immediately below the source which is used for irrigation and by the hatchery.

The channel meanders in a low gradient channel across the Ruby valley. Channel width ranged from 10 to 30 ft with a mean depth of 12 inches. A gravel/cobble substrate is covered almost entirely by aquatic vegetation and fine sediments. The riparian zone is in poor condition with woody species found only near the mouth.

In 1984, a commercial hatchery and processing plant was built .5 mile downstream from the spring. Water was diverted to the hatchery through an old irrigation diversion channel. The effluent runs into a ditch and enters directly into the Ruby River. There are 18 large circular outside raceways. In early 1986, Hagen Western Fishery began producing 10-12 inch rainbow trout and rainbow/cutthroat hybrids for markets in Colorado. Problems within the hatchery have occurred as a result of the use of brood stock from Colorado and Idaho.

Habitat Trends and Limiting Factors

Overuse by cattle has severely reduced the quality of fisheries habitat in Silver Springs. Stock water at the source generates excessive amounts of silt. The entire channel has been widened and is dewatered during the growing season from irrigation and hatchery withdrawl. Gas supersaturation may also be limiting the trout populations in the spring channel (JimPeterson, pers. comm.).

Fisheries

Limited fisheries data have been collected on Silver Springs. One electrofishing pass above the mouth occurred in May, 1979 (Jerry Wells, pers. comm.). Sixteen brown trout were found ranging in length from 5.3 to 14.9 inches. The mouth of the channel opens to allow spawning from the Ruby River. No spawning activity has been documented. No fish were observed in the channel in 1988 (Jim Peterson, pers. comm.).

Potential Value and Management Recommendations

The resident sport fishery and spawning value of Silver Springs cannot be met with the springs' current uses. With approximately 30 cfs bubbling out of the ground at a year round temperature near 50°F, the water quality and quantity of the lower Ruby River could be greatly enhanced if the entire flow of Silver Springs was to reach the river. Dewatering of the lower Ruby during the summer months is an annual problem. The Ruby's potential as a sport fishery has also been depressed as a result of excessive sediment bedload. The clear, high quality water of Silver Springs could enhance water quality conditions of the main stem. Main stem Spawning in Silver Springs could contribute substantially to the river's population.

A survey of the fisheries and habitat conditions of Silver Springs should be conducted to document current status. An instream flow reservation should be filed on the springs. Landowners should be approached to assess interest in conservation easements or fencing of the springs and its channel if funding were available. The potential of gas superstaturation should be investigated.

BEAVERHEAD RIVER SLOUGH COMPLEX

Numerous "sloughs" occur in the floodplain between the Beaverhead and Big Hole Rivers below Dillon, Montana. Although some anglers and biologists alike consider these sloughs to be spring creeks, the source of the water cannot be traced to one major spring or a series of springs. It is my opinion that these slough channels are abandoned Beaverhead River channels or high water channels that are no longer used by the river and have filled with groundwater. Although important fisheries in their own right and by some definitions spring creeks, these streams will not be addressed in this inventory.

Included in the list of recognized sloughs in the Beaverhead are Albers, Schoolhouse, Owsley, Stodden, Selway, California, Jacobs, Leonard, and Third sloughs and Mill Creek Slough in the Ruby.

MINOR SPRINGS IN THE BEAVERHEAD DRAINAGE

Brown's Spring cascades from cliffs above the river and flows in a 300 yard channel before entering the Beaverhead. The springs were discussed in the Lewis and Clark journals. Trout potential is limited due to water temperatures of 70°F (21°C). The landowner raises goldfish in ponds filled by diverted spring waters. A flow of 6 cfs was measured by the Montana Bureau of Mines (1981) and water quality data were collected (Appendix A).

Lovell's Warm Springs, is located in the foothills of the Blacktail Range east of the Beaverhead River. Water temperatures range from 67 to 72°F (19 to 22°C) (MBMG 1981). The spring has been dammed for use in the East Bench Irrigation System, creating a small reservoir. An artificial channel connects the reservoir to the irrigation canal. A flow of 6.6 cfs was measured in 1981 by the MBMG. The high temperatures limit trout potential in Lovell's Springs. Goldfish and carp were observed on the day of the site visit in August, 1985.

Warm Springs Creek, located in the upper Ruby River drainage, is a mountain stream affected by warm springs approximately 3 miles above it mouth. These springs contribute approximately 25% of the stream's base flow. The springs have an impact on the stream's water temperature and fishery. Water temperatures recorded in the winter months were 69 to 70° (20 to 21°C) (Norm Peterson, pers. comm.). Water temperatures have limited trout production but have created habitat for a unique species, Noturus flavus, the stonecat, a member of the catfish family. The stonecat is native throughout the Missouri and Yellowstone River drainages and managed to get over the Great Falls on the Missouri (Brown 1971). Warm Springs Creek provides the only habitat for this species above the falls. Warm Springs Creek enhances the water quality of the Ruby River.

Big Sheep Creek, a major tributary of the Red Rock River, has a base flow of 35 cfs. Approximately 35% of the flow originates from springs located 8 miles above the mouth. The effects of the springs on the creek has been one of increased water quality and an increase in size and number of trout within and below the spring section (Jerry Wells, pers. comm.). The springs and their adjacent land have recently been purchased by a group of lawyers from Bozeman.

Lott's Spring Creek flows in a northerly direction for approximately 2 miles before entering the Ruby River near the town of Twin Bridges, Montana. One landowner owns the entire drainage. Flow was estimated at less than 2 cfs at the time of the site visit in August, 1985. Land uses include cattle grazing and hay production. Current recreational use on the spring creek is limited to a children's fishery. Brook trout surveyed range in length from 2 to 12 inches. Mottled sculpin were the only nongame species surveyed. Channel width ranges from 2 to 8 feet with a mean depth of 6 inches. Substrate composition was 100% fines

covered by scattered clumps of aquatic macrophytes. Woody riparian vegetation was completely lacking and grasses and cattails were the major species observed. The creek is in a deteriorating condition and is periodically cleared to prevent aquatic plant build up. Current land uses in the drainage and the stream's size severely restrict the potential value of Lott's Spring Creek as a main stem spawning area or as a major residential sport fishery.

JEFFERSON RIVER DRAINAGE

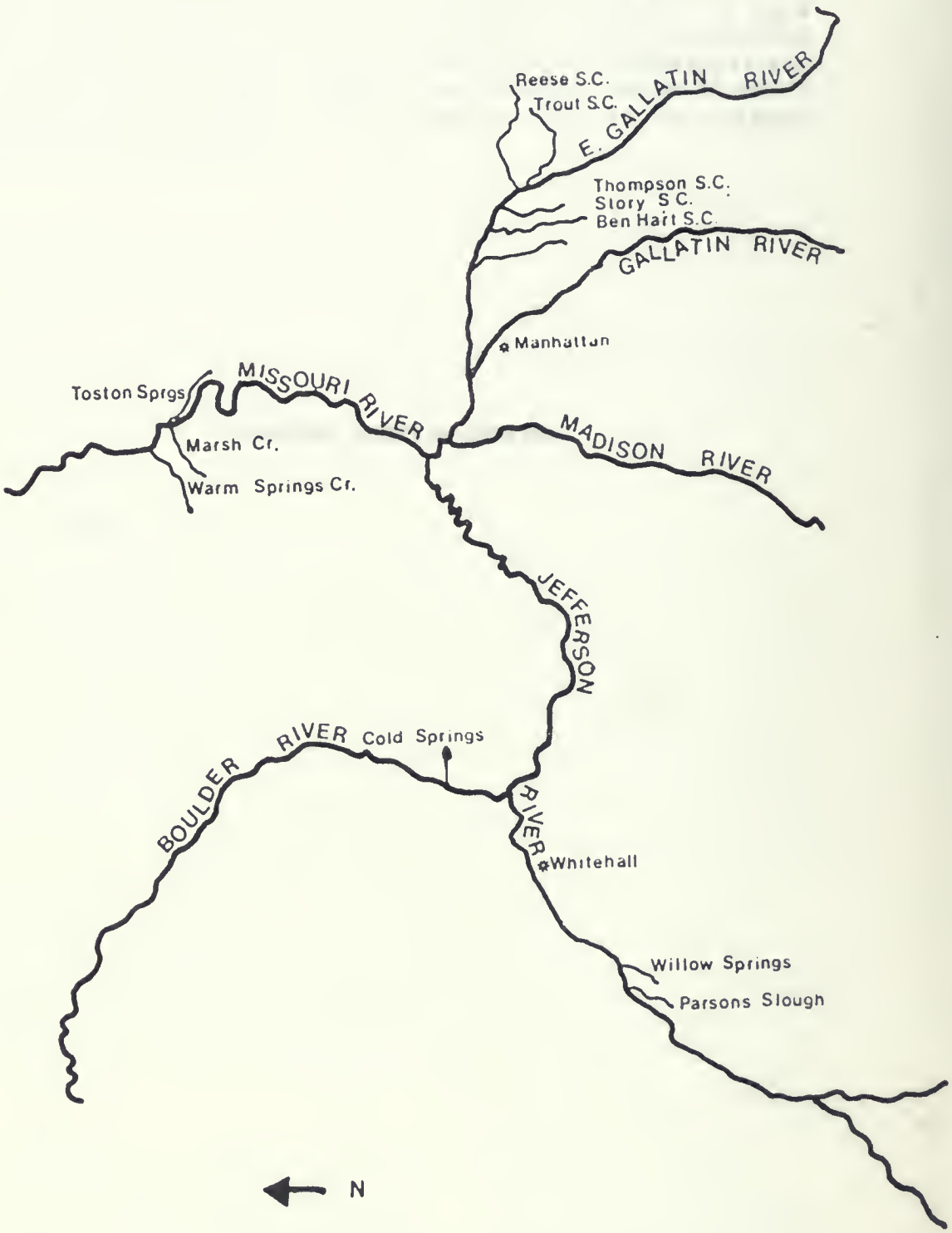


Figure 5. Jefferson River Drainage, upper Missouri River Drainage and E. Gallatin River Drainage.

PARSON'S SLOUGH

Region: 3 Water Code: 10-5460
Legal Description: Origin:T01S,R05W,Section 34BA
Mouth: T01S,R05W,Section 16CD
County:Madison

General Description

Parson's Slough flows in an easterly direction for approximately 4 miles before entering the Jefferson River near the town of Waterloo, Montana. The land adjacent to Parson's Slough is currently used for cattle grazing and hay production. The slough is owned by one landowner but two landowners control the water rights. Access is limited to friends and family of the landowner. The channel is uniform in width and has a nonmeandering nature, giving it the appearance of a large irrigation ditch. The channel may be an abandoned overflow channel of the Jefferson River. No spring source has been identified and surfacing groundwater is thought to be the slough's origin.

Physical data collected on Parson's Slough have included channel description, flow, and temperature. Width ranges between 20 to 30 feet with a depth range of 1 to 3 feet. Velocity is extremely low with the majority of the channel in a run. An undersized culvert decreases velocity further. Flow was estimated at 15 to 18 cfs and water temperature was 58°F (14°C) in August, 1985. The substrate is a mixture of gravel/cobble with the majority covered by sediment and aquatic vegetation. Instream cover consists of large mats of aquatic macrophytes.

Cattails, grasses, forbs, and clumps of willow contribute to the riparian zone of Parson's Slough. Approximately 50% of the streambanks have woody species in the riparian zone with the remainder of the bank being open.

Habitat Trend and Limiting Factors

Agricultural practices in the Jefferson River valley has degraded the habitat of Parson's Slough. The banks are open and the channel dewatered during the irrigation season. The channel's uniformity reduced habitat diversity to slow runs.

Fisheries

No fisheries data have been collected on Parson's Slough. Spawning by Jefferson River trout has not been documented in the slough. In 1987, 152 brown trout removed from Willow Springs during a rehabilitation project were planted in the slough (Bruce Rehwinkel, pers. comm.).

Potential Value and Management Recommendations

A fisheries survey should be conducted on Parson's Slough to document resident population status and Jefferson River spawner use. Fencing of the riparian zone would help narrow the channel over time, but extensive habitat improvement structures, dredging, and filling would be needed to create any significant changes to the channel.

WILLOW SPRINGS

Region: 3 Water Code: 10-8020
Legal Description: Origin: T01S, R05W, Section 15AC
Mouth: T01S, R05W, Section 13AA
County: Madison

General Description

Willow Springs, a tributary to the Jefferson River, flows for approximately 1 mile in an easterly direction before entering the river near Waterloo. Land uses in the Jefferson Valley consist of cattle grazing and hay production. One landowner owns the entire length of Willow Springs and stream access is restricted to family and friends. Flow in Willow Springs was measured in August, 1988 at 15 cfs (Bruce Rehwinkel, pers. comm.). Water temperature at the source was 52° (11°C). The spring originates from a low area in a hay field. An irrigation withdrawl system is located at the source. Irrigation return and overflow from the Parrot Ditch enter the lower section. Substrate is a clean gravel/cobble mixture with numerous clumps of aquatic plants. Fines have accumulated in the deeper pools and runs.

The riparian zone of Willow Springs is composed of willow, alder, grasses, sedges, and forbs. Cattle use in the upper section left the banks open and raw. The lower section has excellent bank cover with woody species lining the majority of the stream.

The rainbow trout population of the upper Jefferson River is limited due to lack of suitable spawning habitat (Bruce Rehwinkel, pers. comm.). Spawner use has been documented in only one creek in the drainage, Hells Canyon. In an attempt to increase rainbow spawning habitat, the landowner on Willow Springs was approached to discuss habitat protection in the fall, 1985 (Bruce Rehwinkel, pers. comm.). A "gentlemen's agreement" between the landowner and the DFWP established a habitat improvement plan for the creek. The work began in 1986. In order to fence the stream, two bridges were installed for stock and vehicle movement. One was across the lower river, the other at the ranch house near the source. The stream was than fenced from the mouth to the the ranch. During 1987, velocity was increased through the removal of numerous willow bars in the channel. The banks were seeded with Garrison Creek foxtail. The Butte Trout Unlimited Chapter volunteered their time to work on the project but much of the work was done by the area DFWP fisheries biologist. The project was funded by monies from a Renewable Resource grant, DFWP, and the Butte Chapter of Trout Unlimited.

Habitat Trend and Limiting Factors

The habitat trend on Willow Springs is improving with the extensive rehabilitation effort. Fencing out livestock has reduced channel width by 60 percent. Velocities has increased and banks are now stabilizing. (Bruce Rehwinkel. pers. comm.). Silt has been cleared in many areas and clean gravels are exposed. The DFWP has filed on a water reservation for Willow Springs.

Fisheries

A study was conducted on the fish habitat, water chemistry, and instream and bank cover of Willow Springs in 1982 by a Montana State University class (White and Skaar 1986). Brown trout, rainbow trout, brook trout, and mountain whitefish were found in the section. Trout numbers were low in the upper section at 13 trout per 300 feet. Trout numbers improved to 100 fish per 300 feet in the lower section. The report concluded instream habitat was the limiting factor in the upper section. The lower section with higher numbers was still not meeting its potential. Brown trout was the predominant fish present with a few individuals 12 to 18 inches in length. Most of the trout were less than 7 inches.

In 1987 the entire stream was electrofished in order to remove unwanted populations prior to egg plants of rainbow trout (Bruce Rehwinkel. pers. comm.). A total of 62 brook trout over 4 inches, 152 brown trout, 1 sucker spp., and 1 rainbow trout were collected.

In 1987, rainbow eggs were taken from Hells Canyon Creek and raised in the USFWS hatchery in Bozeman for later imprint planting in Willow Springs. As a result of the egg take in 1987, 8,000 2.5 inch fish were planted in the fall and another 2,400 yearlings were planted in the spring of 1988. From the egg take of 1988, 4,500 rainbow trout fingerlings were planted in the fall and 2,000 yearlings will be planted in the spring of 1989. Eggs will again be taken in the spring of 1989 to complete 3 years of imprint plantings in Willow Springs. Returning spawners are expected in the spring of 1990.

Potential Value and Management Recommendations

It is hoped through the three years of imprint planting of rainbow trout and the extensive habitat improvements to Willow Springs that the Jefferson River rainbow trout fishery will be improved. If gravels are not sufficiently cleaned by the fall of 1989, a suction dredge from the Deer Lodge National Forest will be used.

COLD SPRINGS CREEK

Region: 3 Water Code: 10-1900
Legal Description: Origin: T02N,R02W,Section 06D
Mouth: Same as origin
County: Jefferson

General Description

Cold Springs flows into the Boulder River from a northwesterly direction approximately 1 mile northeast of the town of Whitehall. One landowner owns the springs and the existing channel and ponds. Two landowners have water rights to the springs and use it seasonally for irrigation. Cattle grazing only occurs in the drainage during the winter months. Cold Springs has a total length of less than 1 mile.

Substantial channel alterations occurred in 1977 when a commercial rainbow trout hatchery was constructed. A complex series of ponds, raceways, and drainage channels were built to raise rainbow trout for the Jumping Rainbow Ranch. The structures have deteriorated considerably since the hatchery was abandoned in 1981. Public access to Cold Springs is by permission from the landowner.

Two channels from Cold Springs enter the Boulder River with an estimated flow of 40 to 50 cfs. Water temperature in August, 1985 was 54°F (12°C). The channels are 6 to 15 feet wide with a depth range of 6 to 18 inches. Substrate composition is a cobble/gravel mixture free of sediment accumulation. Riparian species consisted of willow, alder, grasses, forbs, and sedges. Woody bank cover shades approximately 50% of both channels.

Habitat Trend and Limiting Factors

The fisheries habitat of Cold Springs is currently in a static condition. The springs continue to run through the numerous abandoned hatchery structures.

Fisheries

No biological data have been collect on Cold Springs. Brown trout are the only species recorded by anglers. Both channels are clear for upstream migration from the Boulder River. The river below the springs are used by spawning brown trout (Bruce Rehwinkel, pers. comm.).

Potential Value and Management Recommendations

A fisheries survey should be conducted on Cold Springs to document resident populations and spawning use. The springs contribute the majority of the flow to the east channel of the Boulder River during the irrigation and winter seasons (Bruce Rehwinkel, pers. comm.). The potential of these springs as a resident fishery and spawning habitat and added water quality and quantity to the Boulder River is substantial. Management needs include removal of all raceway structures and reconstruction of a stream channel and riparian zone. An instream flow reservation should be filed on the stream's water.



EAST GALLATIN RIVER DRAINAGE

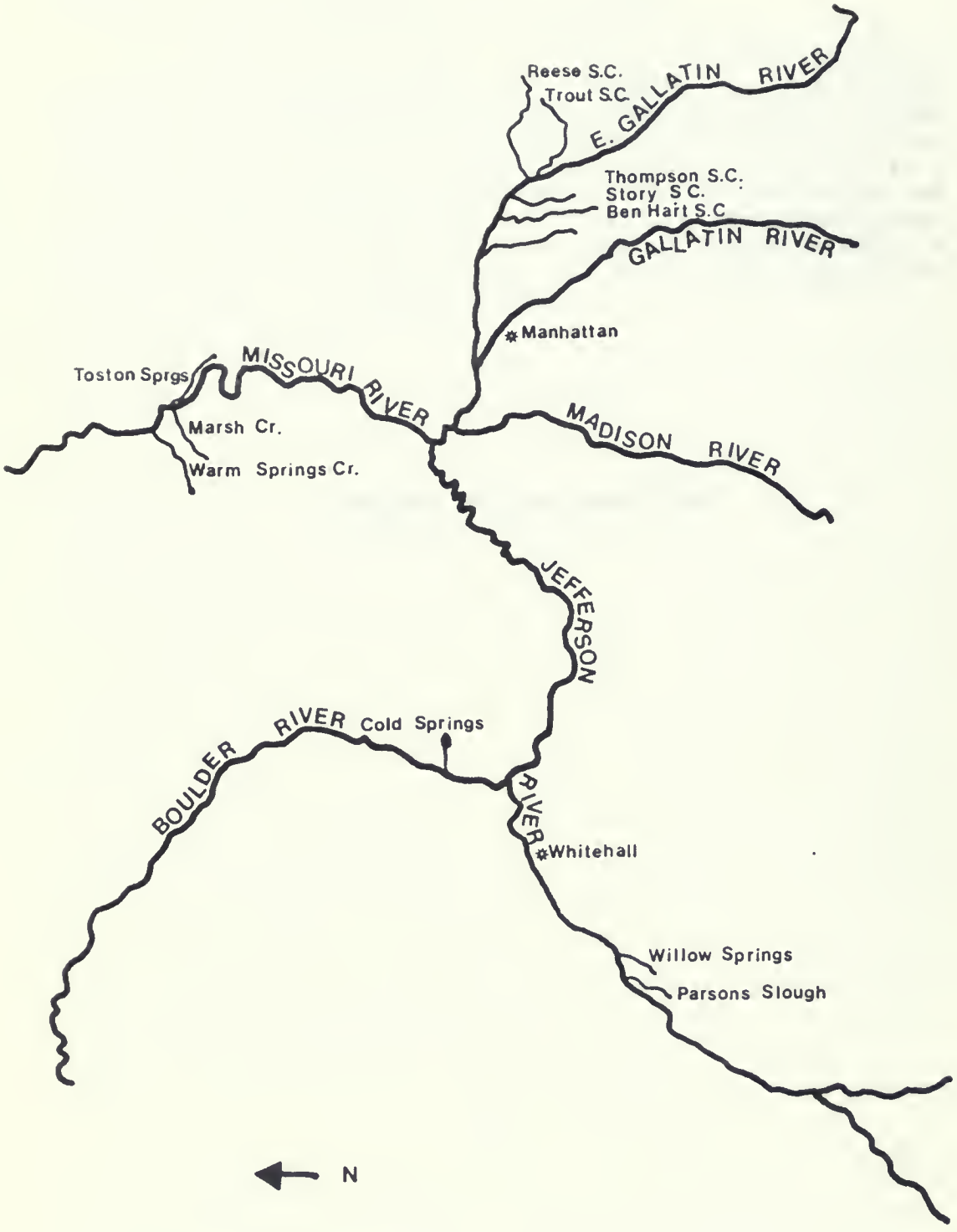


Figure 6. East Gallatin River drainage map.

EAST GALLATIN SPRING CREEK COMPLEX

A series of streams arising in the Gallatin Valley originate primarily from surfacing groundwater created from snowpack in the Bridger and Gallatin Mountain ranges. Irrigation return water augments their flows during the summer months. These streams include Ben Hart, Hess, Gibson, Story, Thompson, Trout (Spring Branch), BullRun, and several minor streams originating in the same manner.

Land use in the East Gallatin valley includes cattle grazing, feedlots, and hay and alfalfa production. The entire valley is in private ownership. Access to many of the streams is allowed by landowner permission. There is no formalized habitat protection on any of the streams or their adjacent lands.

Considerable habitat deterioration has occurred to many of the creeks as a result of agricultural practices. Streamside vegetation consists of willow, alder, grasses, and forbs except in areas with intense cattle use. Extensive bank erosion is apparent on many sections of creeks. Stream channels have been widened and depth decreased. In much of the stream channel, the cobble and gravel substrate has been covered with sediment. In many cases, exposed gravels are cemented limiting spawning habitat.

Sport fisheries still exist in many of the creeks, with rainbow and brown trout occassionally exceeding two pounds. Spawning use of these creeks from the East Gallatin has not been documented.

Inventories need to be conducted on the fisheries and habitat of the East Gallatin spring creeks. Management strategies for each creek could than be outlined including conservation easements, habitat rehabilitation, and fencing. In the past, public agencies and private organizations have been reluctant to invest in the rehabilitation of these spring creeks because of their private ownership and varied land uses. Inventories could help identify streams with the highest potential and the least land use conflict.

TROUT or SPRING BRANCH CREEK

Region: 3 Water Code: 09-5700
Legal Description: Origin: T01N, R05E, Section 25A
Mouth: T01N, R05E, Section 19DA
County: Gallatin

General Description

Trout Creek, or Spring Branch Creek, enters the East Gallatin River at mile 20.5 after flowing in a southeasterly direction for 4 miles. The springs are scattered throughout the length of the stream as it meanders through fertile agricultural land. The channel width ranges from 5 feet in its headwater area to 20 feet near its mouth with a mean depth of 12 inches. The U.S. Bureau of Reclamation measured 5 instantaneous flows on Trout Creek in 1952 and 1953. Flows ranged from 7.7 to 12.0 cfs. The river uses Trout Creek as an overflow channel during spring runoff. This is evidenced by severe bank and bed scour throughout the lower channel. Water quality data collected by Holton (1953) indicated water high in natural productivity. Woody riparian habitat decreases in a downstream direction. The banks near the mouth are completely open as a result of cattle use.

Fisheries

Rainbow, brown, and brook trout and mountain whitefish were the game species inventoried throughout the length of the stream (Holton 1953). Nongame species include mottled sculpin, sucker sp., and longnose dace. Main stem spawner use was indicated by the large number of young-of-the-year trout and large brown trout up to 25.5 inches in length (Holton 1953). A population estimate conducted in 1952 using a mark-recapture method found 287 trout per 1,000 ft. Species composition included 72 percent rainbow, 25 percent brook trout, and 3 percent brown trout. Only 3 percent of the trout were greater than 7 inches.

A study conducted in 1962 and 1963 comparing physical, chemical, and certain biological factors showed little change since 1952 (Wipperman 1963). Fisheries inventories found brook trout as the dominant species in the headwaters and rainbow trout dominate in the lower reaches. Total number for all trout species was 22 percent less but total weight was 49 percent more. Brown trout numbers increased but brook and rainbow trout numbers had declined.

No further fisheries data have been collected since 1963. Present population status is unknown and is believed to have declined considerably as a result of land use practices.

REESE SPRING CREEK

Region: 3 Water Code: 09-4826
Legal Description: Origin: T02N, R06E, Section 32B
Mouth: T01N, R05E, Section 18A
County: Gallatin

General Description

Reese Spring Creek flows in a southerly direction for less than 4 miles before entering the East Gallatin River near Belgrade. Channel width ranges from 10 to 18 feet with a mean depth of 12 inches. Flows were measured by the USGS in 1952 and 1953 near the mouth of the creek. Mean monthly flows were 6.7 and increased to 45.6 cfs during the irrigation season (Hackett et al. 1960). Stream morphology is dominated by runs, 20 percent is pool habitat, and 10 percent in riffles. A water temperature of 59°F (15°C) was recorded in July, 1985. In a study conducted in the late 1970s, suspended sediment and fecal coliform levels were found to exceed state standards (Shouse 1977). Riparian habitat was considered good with over 50 percent of the banks covered by overhanging woody species. Species composition included willow, grasses, and forbs.

Fisheries

Fish populations in a 1,000 feet section of Reese Spring Creek were surveyed by electrofishing in October, 1980 (Region 3 files). Brown trout, rainbow trout, brook trout, and mottled sculpin were inventoried (Table 1). The standing crop of brown and rainbow trout were estimated using a mark-recapture method. The estimate calculated 548 brown trout and 28 rainbow trout. (Table 2).

Table 1. Summary of electrofishing survey in Reese Spring Creek in a 1,000-ft section located in T01N, R05E, Section 10.

Species	No. Captured	Length Range(inches)
Brown Trout	229	3.2-19.1
Rainbow Trout	32	3.3-11.5
Brook Trout	7	4.7-9.8

Table 2. Estimated standing crop of brown and rainbow trout in a 1,000 ft section of Reese Spring Creek in October, 1980.

Species	Length Group (inches)	Per 1,000 ft. Number	Pounds
Brown Trout	3.2- 5.9	437	
	6.0- 9.9	61	
	10.0-12.9	50	
		548(±163)	60(±9)
Rainbow Trout	4.5-11.5	28(±6)	8(±2)

GIBSON SPRING CREEK

Region: 3 Water Code: 09-2150
Legal Description: Origin: T01N, R04E, Section 16
Mouth: T01N, R04E, Section 04
County: Gallatin

General Description

Gibson Spring Creek flows for approximately 2 miles before entering the East Gallatin River at river mile 9.3 near the town of Manhattan. Channel width ranges from 6 to 15 feet with a mean depth of 10 inches. The USGS measured flows in Gibson Spring Creek in 1952 and 1953 (Hackett et al. 1960). Mean monthly flows ranged from 8.9 to 19.5 cfs. Increased stream gradient maintains a clean substrate near the mouth. The remainder of the channel has an accumulation of fines over much of the gravel and cobble substrate. The riparian zone contains willow, alder, overhanging grasses, and forbs. Near the mouth, over 50 percent of the bank is covered by woody species. Lands along the upstream reaches are badly overgrazed and woody vegetation is scarce.

Fisheries

No fisheries or other biological data have been collected on Gibson Spring Creek. Angler data indicated the presence of rainbow and brown trout.

THOMPSON SPRING CREEK

Region: 3 Water Code: 09-6346
Legal Description: Origin: T01N, R05E, Section 32 CC
Mouth: T01N, R04E, Section 13 DA
County: Gallatin

General Description

Thompson Spring Creek flows in a southwesterly direction for 6.8 miles before entering the East Gallatin River at river mile 18.6 near Belgrade. There are at least 6 landowners in the drainage. A dairy farm is located in the headwater area.

Land development on a 400 acre ranch bordering 2.9 miles of the creek was the center of much attention in the late 1970s and early 1980s. In an attempt to prevent subdivision of the ranch, the Madison-Gallatin Chapter of Trout Unlimited and the Gallatin Wildlife Association requested the Montana State Legislature and the Fish and Game Commission to purchase 285 acres on the creek. The clean water flowing into the East Gallatin, preservation of a dwindling resource (i.e. spring creeks), and protection of fish spawning grounds were cited as reasons for the purchase. In March, 1979, the Commission denied the purchase based on high cost, feedlot activites in the headwater area, existing heavy sediment problems, low fish populations, the need for habitat rehabilitation, and conflicting ownership within the acquisition area. The land was subdivided into 20-30 acre tracts for homesite construction in the early 1980s.

Physical data collected on Thompson Spring Creek are limited. Channel width ranges from 15 to 30 feet with a mean depth of 12 inches. Flows of 25.5 to 40.1 cfs were measured by the USGS in 1952 and 1953 (Hackett et al. 1960). Only ten percent of the gravel/cobble substrate is exposed. The remainder is covered with sediment 0.1 to 2.0 ft thick and aquatic plants(MDFG 1979).

Fisheries

Rainbow and brown trout were inventoried as common and brook trout less abundant in a survey conducted in 1975. Tiger trout have been reported by anglers. Nongame species include longnose dace and mottled sculpin. A population estimate on a 1,000 foot section in 1968 calculated 552 trout with 54 percent brown trout, 40 percent rainbow trout, and 6 percent brook trout. By 1975, total trout numbers were 362, or 65 percent of the population found in 1968. Considerable habitat deterioration occurred during this time period (Dick Vincent, pers. comm.). Habitat is reported to be improving on a fenced portion of the creek (Fred Nelson, pers. comm.). Spawner use by East Gallatin trout has not been documented.

STORY SPRING CREEK

Region: 3 Water Code: 09-6080
Legal Description: Origin: T01S, R04E, Section 11 DB
Mouth: T01N, R04E, Section 03 CA
County: Gallatin

General Description

Story Spring Creek flows for 7.1 miles in a southwesterly direction before entering the East Gallatin River at river mile 10.6 near Belgrade. A fee of $15.00 has been charged to fish the lower 2.2 miles of the creek. A four rod per day limit has been placed on the section.

Physical and chemical data collected on Story Spring Creek are limited. Channel width ranges from 12 to 20 feet with a mean depth of 12 inches. Mean monthly flows of 11.6 to 24.7 cfs were measured on Story Creek by the USGS in the early 1950s (Hackett et al. 1960). Flows increased during spring runoff and again during the irrigation season. The gravel/cobble substrate is relatively clean and uncompacted in comparison to other East Gallatin spring creeks. Water turbidity increases from irrigation return during the growing season.

Fisheries

Brown trout and rainbow trout are considered common in Story Creek with an occasional brook trout. DFWP fisherman logs from 1967 to 1980 reveal length of trout ranged from 8 to 15 inches. Brown trout over 20 inches have also been reported (Fred Nelson, pers. comm.).

BEN HART CREEK

Region: 3 Water Code: 09-0304
Legal Description: Origin: T01S, R04E, Section 03 BD
Mouth: T01N, R04E, Section 04 AC
County: Gallatin

General Description

Ben Hart Creek flows 3 miles in a northerly direction before entering the East Gallatin River at river mile 14.3 near Belgrade. This is one of the largest spring creeks in the East Gallatin and is considered the least degraded (MDFG 1979). The stream is owned by one family with little chance of land purchase at this time (Dick Vincent, pers. comm.). Mean monthly flow ranged from 25 to 33.2 cfs in 1952 and 1953 (Hackett et al. 1960). Numerous wet areas were ditched to drain into Ben Hart causing stream flows greater than what naturally occurred. Channel width ranged form 15 to 30 feet with a mean depth of 8 inches.

Fisheries

A fisheries survey has not been conducted on Ben Hart Spring Creek. Based on DFWP fisherman logs, the sport fishery is dominated by brown and rainbow trout with an occasional brook trout. Total length for trout species recorded in the logs ranged from 6 to 15 inches. Catch rates averaged a little over .5 fish per hour. Tiger trout have also been caught in Ben Hart Spring Creek (Fred Nelson, pers. comm.).It is not know if trout from the East Gallatin River use Ben Hart for spawning habitat.

MADISON RIVER DRAINAGE

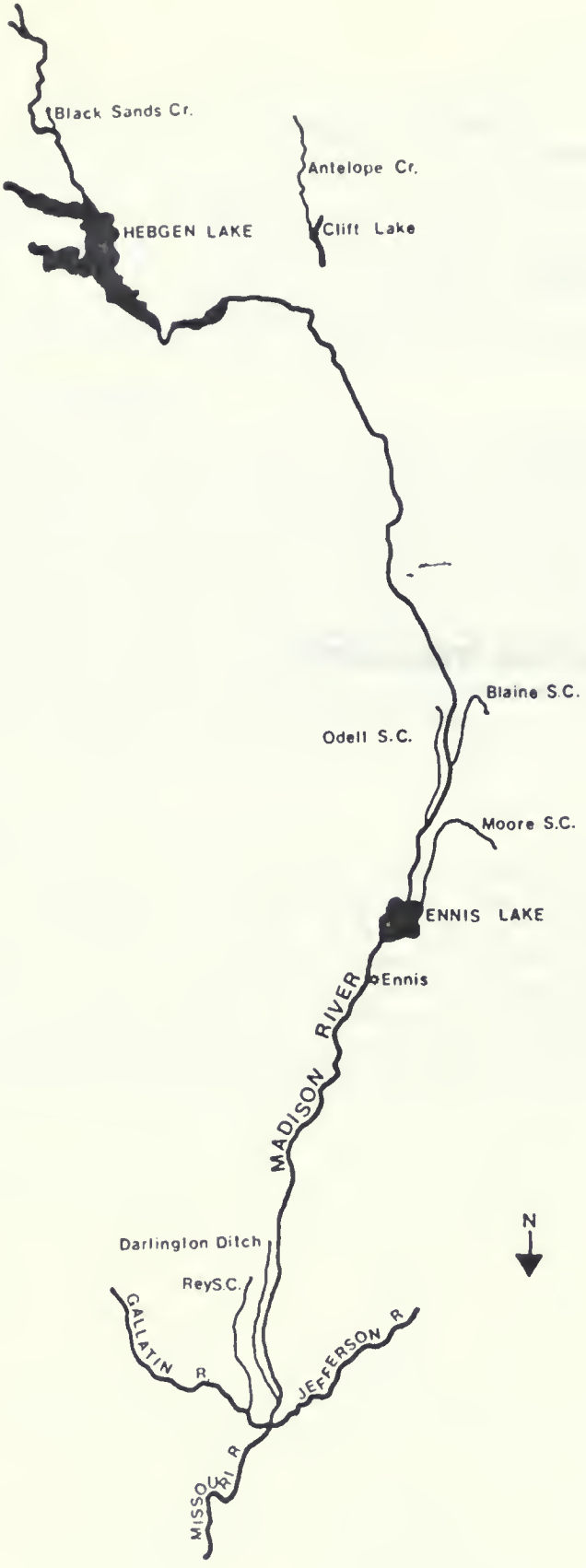


Figure 7. Madison River drainage.

BLACK SAND CREEK

Region: 3 Water Code: 13-0528
Legal Description: Origin: T13S, R05E, Section 31AC
Mouth: Same as Origin
County: Madison

General Description

Black Sand Creek flows for approximately .5 mile in a northwesterly direction before entering the South Fork of the Madison River. The South Fork is now a tributary to Hebgen Lake, a reservoir on the upper Madison River. The creek flows entirely on Gallatin National Forest land. The major land use in the drainage is recreation. The creek's channel is volcanic in origin and its water, relatively sterile. It has an estimated flow of 20 cfs in an undefined channel ranging up to 50 feet wide and 6 inches deep. Its riparian zone consists of grasses, sedges, and lodgepole pine and is open throughout much of its length.

Habitat Trend and Limiting Factors

The habitat trend of Black Sand Creek is static.

Fisheries

The resident fish population of Black Sand Creek has not been surveyed. It is considered the primary spawning stream for Hebgen Lake rainbow and brown trout (Dick Vincent, pers. comm.). A survey in June, 1982 inventoried 46 rainbow trout ranging in length of 13.9 to 18.9 inches and 19 brown trout ranging from 4.7 to 17.4 inches.

Potential Value and Management Recommendations

An instream flow reservation should be filed on Black Sand Creek to protect this critical spawning area to the Hebgen Lake trout population.

ANTELOPE SPRING CREEK

Region: 3 Water Code: 13-0120
Legal Description: Origin: T13S, R23E, Section 05AB
Mouth: T12S, R01E, Section 36AC
County: Madison

General Description

Antelope Spring Creek flows in a northerly direction for 8.5 miles before entering Cliff Lake, a popular fishing lake in the Madison River drainage. The creek is located on the Beaverhead National Forest and private land. Three miles above the mouth is a 1.5 mile section privately owned. Water is diverted to irrigate hay fields. Other major land uses in the drainage are grazing and recreation.

Physical characteristics of the channel include a width varying from 1.5 feet at the headwaters to 30 feet near the mouth. The DFWP collected flows on the creek from May to September, 1980 (MDFWP 1981). Flows were fairly constant during the period, ranging from 14.2 to 15.3 cfs. Two water rights are held on the creek totaling 10 cfs. The substrate composition is a gravel/volcanic origin rock mixture with fines accumulated in the pools. Species in the riparian zone include willow, sedges, grasses, and forbs. Damage by stock use is evident but not excessive in the riparian zone.

Habitat Trend and Limiting Factors

The habitat condition remains relatively static in Antelope Creek. Dewatering may occur seasonally due to irrigation diversions.

Fisheries

Rainbow trout were the only game species surveyed in Antelope Creek (MDFWP 1981). White sucker and mottled sculpin were the two nongame species surveyed. Antelope Creek has been identified as critical spawning and rearing habitat for Cliff Lake rainbow trout. Natural reproduction in Antelope Creek and other tributaries maintains the sport fishery of the lake.

In July, 1980 a 1,000 ft section on Antelope Creek located in T12S, R01E, Sec. 36A was surveyed by electrofishing (MDFWP, 1981). Sampled rainbow trout ranged from 2.1 to 16.0 inches in length. A population estimate calculated 247 ($\pm$76) rainbow trout ina 1,000 feet section with a total biomass of 54 ($\pm$13) pounds. There was an estimated 132 trout over 6 inches.

Potential Value and Management Recommendations

An instream flow reservation should be filed on Antelope Creek to insure the protection of a critical spawning area to Cliff Lake. The DFWP is currently working on the reservation process for the entire upper Missouri River.

BLAINE SPRING CREEK

Region: 3 Water Code: 13-0560
Legal Description: Origin: T07S, R02W, Section 13CA
Mouth: T07S, R01W, Section 17CC
County: Madison

General Description

Blaine Spring Creek is a tributary to the Madison River, entering at river mile 55.1. Its drainage area is 3.4 mi^2 with a channel length of 5.2 miles. There are three tributaries in the drainage, Trail Creek entering at river mile 0.2, Moran Creek entering at river mile 1.4, and Wigwam Creek at river mile 4.9. Only Wigwam Creek contributes a significant flow to the creek. Two large springs of equal size emerge from a limestone formation to form the creek. The sources converge after flowing for 100 yards.

The creek flows for approximately .75 mile before it is diverted into the USFWS Ennis Fish Hatchery. The hatchery was constructed in 1931 and currently has 18 raceways. The hatchery maintains 6 rainbow brood stocks and produces 20 million eggs on an annual basis (Wes Orr, pers. comm.). The section below the hatchery has been subdivided into 10-20 acre tracts. The lower two miles of the creek are used primarily for agricultural production and are severely dewatered during the irrigation season. Public access is restricted throughout most of the drainage.

Physical and chemical measurements have been taken sporadically in Blaine Spring Creek. Flows measured by the USGS in 1971 and 1972 ranged from 14.6 cfs in June to 34.4 cfs in September. Flows remained between 30.9 to 34.4 for 7 of the 12 months. Mean water temperature at the hatchery is 54°F(12°C) (Wes Orr, pers. comm.). The upper 2 miles of channel is 8 to 20 feet wide with a mean depth of 8 inches. Gradient is high with a substrate composed of clean gravel and cobble. Aquatic vegetation covers approximately 40% of the channel bottom. The riparian zone is dense and is composed of willows, grasses, and forbs. Water quality at the hatchery is characterized by high productivity and low suspended solids (Appendix A). The lower channel loses much of the gradient and velocity and becomes a slow, meandering stream. Channel width ranges from 15 to 40 feet with a mean depth of 18 inches. The substrate is composed entirely of fine silts covered by large clumps of aquatic macrophytes. The riparian zone is healthy and consists of willows, grasses, and forbs. Cottonwoods line the lower one mile of stream.

Habitat Trend and Limiting Factors

Land use practices and severe dewatering in the lower reaches are limiting the fisheries habitat of Blaine Spring Creek. Wipperman (1967) documented 2.3 miles of Blaine Spring Creek being critically affected or dry by dewatering from irrigation.

Fisheries

Rainbow and brown trout have been inventoried in Blaine Spring Creek. Longnose sucker and mottled sculpin are the nongame species present. A 1,000 ft section was electrofished in 1980 at T06S, R01W, Sec. 6 (Fred Nelson, pers. comm.). Brown trout were the dominant species in the section, ranging in length from 3.7 to 16.2 inches. Rainbow trout ranged in total length from 3.7 to 13.4 inches. A brown trout population estimate was calculated for the section using a mark and recapture technique. The brown trout was 438 (±123) with a total biomass of 239 pounds. There were 286 trout greater than 10 inches estimated. Low numbers of rainbow trout (15 individuals) prevented an estimate.

It has not been documented if trout from the Madison River use Blaine Spring Creek as a spawning tributary.

Potential Value and Management Recommendations

The resident trout population of Blaine Spring Creek is substantial for a stream of this size. Every avenue should be explored to protect, enhance, and maintain the creek. An instream flow reservation should be filed on the creek. Purchase of water rights should be a priority if a mechanism to purchase or lease these rights become available. Alternative sources of irrigation water in the drainage should be pursued. Conservation easements with existing landowners should be pursued and fencing of the stream banks should be explored.

ODELL SPRING CREEK

Region: 3 Water Code: 13-4400
Legal Description: Origin: T07S, R01W, Section 09 AC
Mouth: T05S, R01W, Section 34 AB
County: Madison

General Description

Odell Spring Creek parallels the Madison River for 10.3 miles before entering the river at mile 49.0, one mile north of Ennis, Montana. The source of Odell Spring Creek is a series of spring emerging along the east side of the Madison River. The major land use activity in the valley is cattle grazing. Flooding on a seasonal basis has limited homesite and cropland development (MDFG 1979). The mouth of Odell Spring Creek is within the boundaries of a state fishing access. The next two miles, up to Highway 287 bridge, is grazed and creek water is diverted for irrigation.

There are approximately 10 landowners in the drainage. Three major landowners own 80% of the creek. The Granger Ranch owns 2.5 miles above the highway bridge and another 2.0 miles near the headwaters. Access is restricted on the Granger property. The Longhorn Ranch owns the headwater area along the Varney Bridge road and another portion between the two Granger portions for a total of 2.5 miles. A conservation easement has been negotiated by the Montana Land Reliance for the portions of Odell Creek on the Longhorn properties (Jan Konigsberg, pers. comm.). Catch and release only is enforced on the Longhorn Ranch. Access is limited to family and friends. Several smaller landowners along the creek allow public access by permission.

The USGS and the DFWP have measured the flow and other physical characteristics of Odell Spring Creek during the late 1960s and 1970s. Flows ranged from 109 cfs in May to 143 cfs in October. The creek is subjected to overflow from the Madison River during periods of extreme high water and flooding caused by ice jams. Summer water temperatures have been measured from 50 to 56^{o}(10 to 13^{o}C). Channel width ranges from 15 to 60 feet with a mean width of 25 feet in the section above Highway 287 and 35 feet below the highway. Maximum depth of pools in the lower section is 6 feet with a mean depth of 24 inches (MDFG 1979).

The channel is characterized by extensive meanders, a pool-riffle sequence, and increased gradient near the mouth. The substrate composition is a gravel/cobble mixture with over 50% of the substrate covered by fine silts. Bank conditions range from healthy growths of willow and alder and open grassland to open and eroding due to heavy livestock use (MDFG 1979). There are extensive areas of undercut banks and overhanging streambank vegetation. Woody riparian species are limited in the upper 5 miles of creek. Cottonwoods increase near the mouth.

Habitat Trend and Limiting Factors

The habitat trend in Odell Spring Creek is improving as a result of concern by the landowners in the drainage. The conservation easement protects 2.5 miles of the creek from all non-agricultural use (Jan Konigsberg, pers. comm.). The Granger Ranch has reduced their cattle numbers by half since 1985. Stock trampling of the banks is evident along portions of the creek but is usually not extensive. There is only one small irrigation diversion below the highway.

Fisheries

Brown and rainbow trout, mountain whitefish, and an occasional brook trout compose the sport fishery of Odell Spring Creek. Brown trout are the dominant game fish. Arctic grayling historically resided in the stream but have disappeared from the system today (Dick Vincent, pers. comm.). Nongame species in the creek include mountain, longnose, and white sucker; and longnose dace and mottled sculpin. Madison River trout have not been documented using the spring creek. The mouth is braided into several channels (Dick Vincent, pers. comm.).

The effects of stocked hatchery trout on wild trout populations was documented in a study involving Odell Spring Creek in the late 1960s and early 1970s (Vincent 1985). Catchable rainbow trout were experimentally stocked in Odell Creek for the study. Upon documentation of the negative effects of these plantings on the wild brown trout population, stocking was ceased. A population estimate in 1975 reflected the recovered population (Vincent 1985). The estimate calculated 312 brown trout in a 1,000 ft section including 234 trout from 3.5 to 9.9 inches and 78 from 10.0 to 17.9 inches.

Potential Value and Management Recommendations

Protection of the highest quality spring creek in the Madison River drainage is increasing as a result of a conservation easement and reduced cattle use. Every effort should be made to increase this protection through additional easements, public acquisition, and fencing.

MOORE SPRING CREEK

Region: 3 Water Code: 13-4000
Legal Description: Origin: T05S, R01W, Section 33 DCC
Mouth: T05S, R01W, Section 10
County: Madison

General Description

Moore Spring Creek flows in a southeasterly direction for approximately 3 miles before entering Ennis Lake, a reservoir located on the Madison River at river mile 45.8. Fletcher Creek is the only tributary in the drainage. Over 90% of the flow originates from the spring source in the valley. Two landowners divide the drainage, both operating cattle ranches. The spring is used for grazing and stock watering. Access is limited to family members and friends.

Physical data collection has been limited on Moore Spring Creek. A flow measurement of 15 cfs was collected in 1981 (Dick Vincent, pers. comm.). Mean channel width is 21 feet with a mean depth of 12 inches. No woody species are located in the riparian zone. Grasses, sedges, and forbs dominant the riparian zone but offer little cover. Substrate composition is a mixture of cobble and gravel with silt accumulating in the deeper pools. Clumps of aquatic plants are found throughout the channel.

Habitat Trend and Limiting Factors

Overuse by stock has caused bank slumping and loss of riparian zone quality in Moore Spring Creek.

Fisheries

No electrofishing surveys have been conducted on Moore Spring Creek. Based on observations from DFWP personnel, abundant populations of arctic grayling and rainbow trout reside in the lower reaches. The arctic grayling is considered a species of special concern by the State of Montana. In the upper reaches, low numbers of rainbow and brown trout are present. This creek is considered an important spawning stream for trout populations of Ennis Lake (Dick Vincent, pers. comm.).

Potential Value and Management Recommendations

A fisheries inventory should be conducted on Moore Spring Creek to document resident populations and spawner use from Ennis Lake. An instream flow reservation should be filed for the protection of the arctic grayling population. Opportunities for conservation easements from existing landowners should be pursued

and habitat protection encouraged. Fencing of the banks would greatly improve habitat quality.

DARLINGTON DITCH

Region: 3 Water Code: 13-1520
Legal Description: Origin: T01S, R02E, Section 19A
Mouth: T02N, R02E, Section 19C
County: Madison

General Description

Darlington Ditch was originally formed in 1948 by the Army Corps of Engineers. The channel was created as a borrow pit for fill for a flood control dike along the Madison River. The ditch parallels the river for approximately 11 miles before entering the river near its mouth. There is no true spring source for the ditch. The base flow of the creek is provided by surfacing groundwater. There are headgates to the Madison River at the upper and lower ends which are used during the irrigation season to transport Madison River water. The ditch is privately owned except for a two mile portion that was included in a DFWP fishing access on the Madison River.

The ditch is characterized by a wide channel, uniform in width and depth,and a low gradient and velocity. Riparian vegetation is restricted to grasses and forbs and provides no overhanging cover. In 1982, the Madison-Gallatin Chapter of Trout Unlimited reconstructed a .25 mile of ditch to form a .5 mile of stream in the state access area (White 1985). Meanders, including pools and riffles, were constructed, the channel was narrowed and deepened, large rocks were installed to stabilize banks, and willows were planted. Cover structures were placed along meanders during the summer of 1985 (Ray White, pers. comm.). The fishing regulation on the altered section has been changed to catch and release only using artificial flies and lures. In early 1989, an addition .5 mile section upstream from the improved section will be rehabilitated (Fred Nelson, pers. comm.). The existing channel will be narrowed by excavation. The excavated materials will be piled along the banks. Riffles and pools will be created during the alteration. Plantings along the bank will occur in the spring. The Madison-Gallatin Chapter received a $3,500 grant from the Fish America Foundation for the project. Interfluv Inc. will be responsible for the channel reconstruction work.

Habitat Trend and Limiting Factors

Water temperatures are intolerable to trout species during the summer months in most of Darlington Ditch. Channel width and depth and the openness of the banks also reduce trout potential. Flows during the summer months from irrigation diversion are excessive, increasing to 125 cfs (Ray White, pers. comm.). Considerable bank scour has occurred as a result of these flows. The lack of habitat diversity and erratic flow patterns have depressed the trout population. The fisheries habitat in the

altered sections of Darlington Ditch have benefited from the improvements.

Fisheries

Inventories of the fish populations of Darlington Ditch began in 1980 prior to the reconstruction work on the state section. Game species present included brown and rainbow trout and mountain whitefish. Nongame species were mottled sculpin and several species of suckers. The number of trout in the altered section has increased substantially (Table 1). Brown trout in a 300 ft section in the altered area increased from 57 to 769 from 1980 to 1984 (White 1985).

Table 1. Population estimates of brown trout in the altered section of Darlington Ditch prior to and after reconstruction. Estimates are for a 300 ft section (White 1985).

Year	Length Group			
	<8.0"	8-12"	>12.0"	Total
1980	39	6	11	57
1982	4	5	15	25
1983	65	11	17	92
1984	727	36	5	769

Potential Value and Management Recommendations

The potential for Darlington Ditch is severely limited without massive channel alterations throughout its length. The fact that it is not a true spring creek and is part of larger irrigation system should be considered before further spending occurs. The public access provided through the state access is the major factor in continuing to fund reconstruction of portions of the ditch (Fred Nelson, pers. comm.).

REY CREEK

Region: 3	Water Code: 09-4788
Legal Description:	Origin: T01S, R02E, Section 04C
	Mouth: T02N, R02E, Section 20D
	County: Madison

Rey Creek parallels the Madison River for approximately 12 miles before entering the Gallatin River at river mile 2.6. The drainage is privately owned by a number of individuals. Major land uses include cattle grazing and irrigated hay production. The channel ranges in width from 10 to 20 feet with a mean depth of 8 inches. A flow of 8 to 10 cfs was estimated at the time of the site visit in July, 1985. A water temperature of 62° (17°C) was measured at the same time. Stream morphology is a riffle/run sequence with a few pools. The substrate composition is a gravel/cobble mixture covered by accumulated silt and aquatic vegetation. The riparian zone is in poor condition and is dominated by grasses, sedges, and forbs. Clumps of decadent willows are also present.

The fisheries habitat of Rey Creek is in a deteriorated condition. The banks are slumping, the substrate is covered by fines, irrigation return causes turbid conditions, and the drainage is overused by stock.

Brown and rainbow trout have been inventoried in Rey Creek. Mottled sculpin, longnose sucker, and longnose dace are the nongame species present. An abundance estimate has not been conducted on Rey Creek.

Fencing of the creek would greatly improve the riparian habitat of Rey Creek. A fisheries survey should be conducted to document the current population in the creek.

UPPER MISSOURI RIVER DRAINAGE

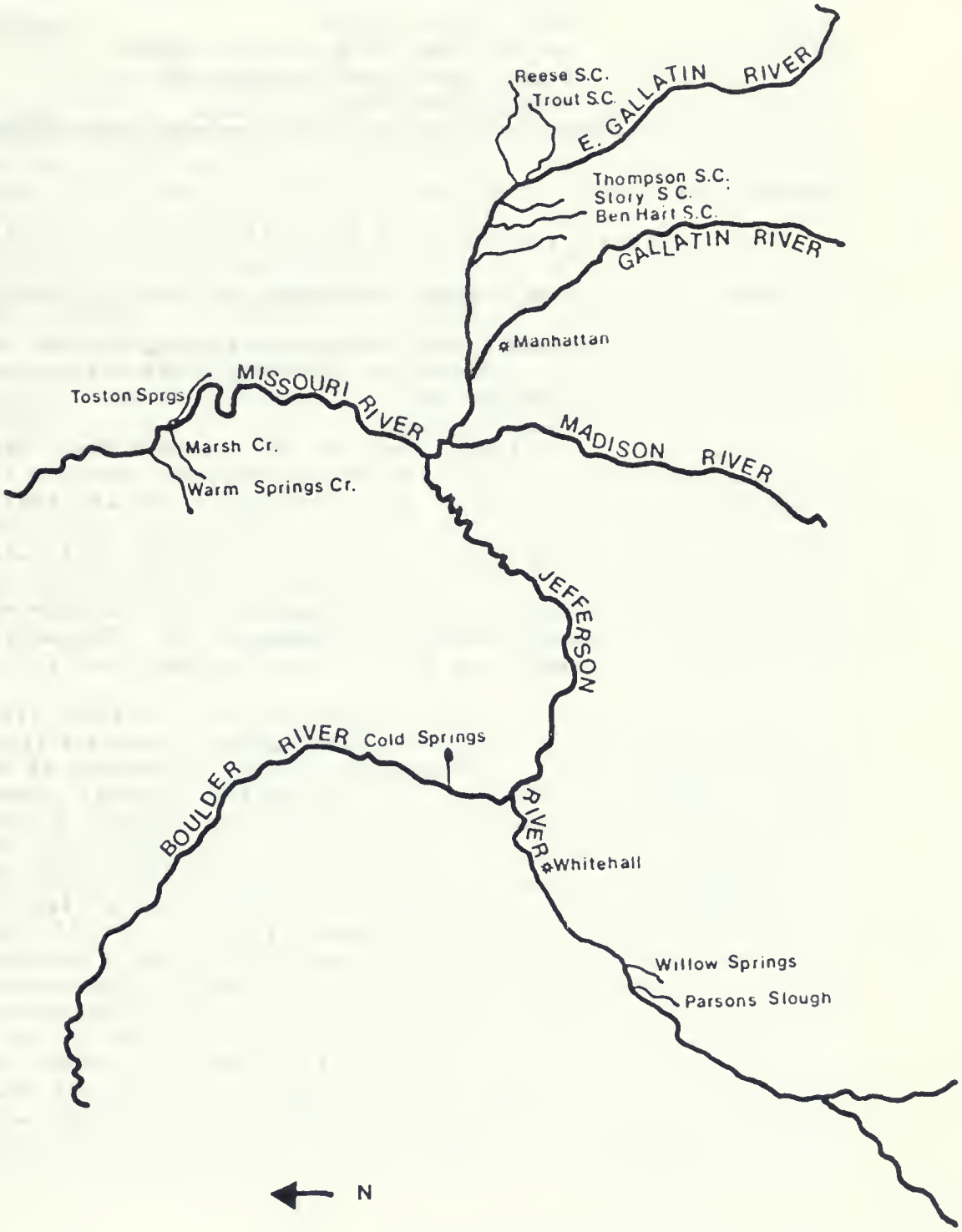


Figure 8. Jefferson River Drainage, upper Missouri River Drainage and E. Gallatin River Drainage.

TOSTON SPRINGS

Region: 3 Water Code: 17-7784
Legal Description: Origin: T04N, R03E, Section 6 DADC
Mouth: T05N, R02E, Section 27D
County: Broadwater

General Description

Toston Springs parallels the Missouri River for 4.5 miles before entering the river at mile 2298.0 near Toston, Montana. The channel,located on a sidehill above the river,was constructed for irrigation purposes. Six landowners hold water rights to the spring. The flow is used almost entirely for irrigation during the growing season. The channel is bordered by the railroad on the east and the river on the west.

Physical and chemical data on the springs have been collected by the USGS and the DFWP. Measured flows were 43.6 cfs in 1985 and 64.4 cfs in 1922. Water temperatures are fairly constant between 53 to 59^{o}F (11 to 15^{o}C). The channel is 15 to 20 feet wide with a depth of 2 to 4 feet. A headgate is located directly below the source. Water quality is excellent and the gravel/cobble substrate mixture is clean with considerable and diverse aquatic macrophytic growth (Appendix A). Vegetative species along the channel are willow, alder, grasses, and forbs.

The springs have been considered for various uses. Commercial production of trout was investigated in the late 1970s. Financial problems with the developers forced abandonment of the idea. Toston Dam, a run-of-the-river irrigation reservoir located on the Missouri approximately one mile above the springs, is being retrofitting for hydroelectric generation. Since mitigation for loss of spawning and rearing habitat for Missouri River trout was not considered during the original construction, mitigation alternatives are now being considered for the retrofitting. Toston Springs has been extensively investigated as a spawning channel. The spawning channel proposal included the construction and lining of a 2.5 mile channel, installation of a headgate to move the water, and a fish ladder to access the channel. Currently, the cost of the project is beginning to exceed the mitigation dollars available. Other mitigation alternatives still being considered include hatchery rearing of wild brown trout eggs collected elsewhere and a smaller rainbow trout spawning channel further downstream.

Habitat Trend and Limiting Factors

Toston Springs fishery potential is limited as a result of its artificial nature and the present use of its water for irrigation. The mouth of the channel enters the Missouri through a culvert which is elevated approximately 3 feet above the river

edge's during most of the year.

Fisheries

Although no biological data have been collected on Toston Springs, it is doubtful that there is a resident fishery. Migration by spawning fish is completely restricted because of the location of the culvert's mouth to the river's edge. Brown and rainbow trout have been observed spawning in the main river in the vicinity of the springs (Bruce Rehwinkel, pers. comm.).

Potential Value and Management Recommendations

Toston Springs could greatly enhance the Missouri River trout population downstream from the dam. The water quality is excellent, the temperature is within the optimum range for trout reproduction, and the flow is considerable and constant.

WARM SPRINGS CREEK AND MARSH CREEK

Warm Springs Creek
Region: 3 Water Code: 17-8112
Legal Description: Origin: T04N, R01E, Section 27AA
Mouth: T05N, R02E, Section 16DB
County: Broadwater

Marsh Creek
Region: 3 Water Code: 17-4464
Legal Description: Origin: T04N, R02E, Section 01BC
Mouth: T05N, R02E, Section 32D
County: Broadwater

General Description

Warm Springs and Marsh creeks flow in a northeasterly direction before entering the Missouri River southwest of the town of Toston. Warm Springs Creek is approximately 8 miles in length and originates from springs forming Plunkett's Lake. There are 5 landowners in the drainage. Cattle grazing and hay production are major land use activities. Access is usually allowed by permission from the landowners.

Limited physical and chemical data have been collected on Warm Springs Creek. Channel width ranges from 6 to 15 feet with a mean depth of 10 inches. Flow in Warm Springs Creek has been measured at 9.7 near the headwaters. Throughout the irrigation season, however, it is used as part of the Crow Creek Irrigation System and receives flows well in excess of natural. This is evidenced by raw banks along much of its course. Over 30% of the substrate composition is boulder size covering the cobble/gravel mixture. Conditions are extremely turbid as a result of the sloughing banks and irrigation return water (Bruce Rehwinkel, pers. comm.). Riparian vegetation is lacking along much of the banks and woody species are only present along the lower reaches. Beaver dams in the lower reaches partially block the channel.

Marsh Creek is a smaller stream, flowing for less than 2 miles. Width of the channel ranges from 6 to 10 feet. The channel has an average depth of 8 inches. Flow was estimated at 5 to 7 cfs in July, 1985. Flows exceed natural during most of the irrigation season. Water temperature was 63^{o}F (17^{o}C) in July, 1985. Substrate composition is a mixture of gravel and cobble. Accumulated fines and thick algal mats have covered much of the substrate. Species composition in the riparian zone consists of willow, grasses, and forbs. Much of the bank is open due to cattle use and excessive flows.

One rancher owning land on both streams is concerned with protecting Missouri River trout during their spawning runs up the streams. He has limited access and allowed only catch and release fishing.

Habitat Trend and Limiting Factors

Excessive irrigation flows and cattle use have deteriorated the fisheries habitat on Warm Springs and Marsh creeks. Natural clay soils have caused considerable turbidity resulting from sloughing banks and high flows. Substrate is armored in much of the channel. As a result of the drought conditions of 1987 and 1988, the flows in Marsh Creek are currently diminishing due to a lack of groundwater recharge.

Fisheries

No resident fisheries data have been collected on Warm Springs and Marsh creeks. Both streams were electrofished in the fall of 1985 to document spawner use from Missouri River system brown trout (Bruce Rehwinkel, pers. comm.). These fish were suspected to be from Canyon Ferry Reservoir. Extensive spawner use in Marsh Creek was documented. Only a few spawning brown trout were captured in Warm Springs Creek.

Potential Value and Management Recommendations

Spawning surveys in the fall should continue to be conducted on Warm Springs and Marsh creeks. Surveys should also be conducted in the spring to document rainbow trout use. Management recommendations include fencing of critical spawning areas and elimination of these streams from the irrigation system (Bruce Rehwinkel, pers. comm.). Because of the more extensive spawner use documented in Marsh Creek, this stream should be given priority if funding would become available.

MISSOURI RIVER DRAINAGE

GREAT FALLS TO JUDITH RIVER

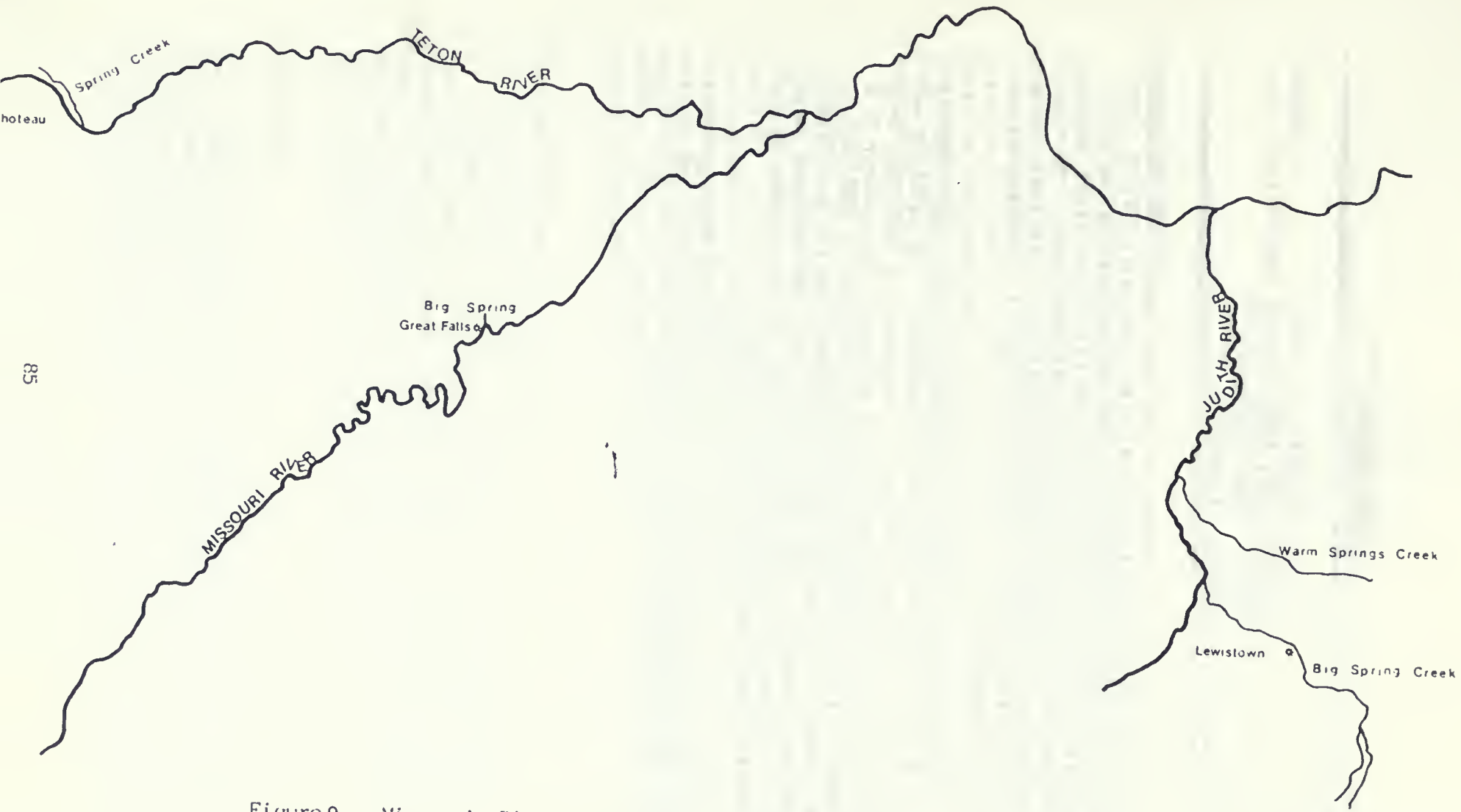


Figure 9. Missouri River drainage; Great Falls to Judith River.

GIANT SPRINGS

Region: 4	Water Code: NA
Legal Description:	Origin: T20N, R04E, Section 33B
	Mouth: Same as Origin
	County: Cascade

Giant Springs are located on the north bank of the Missouri River, two miles north of Great Falls at river mile 2.116.0. The springs run for approximately 100 feet before entering the river. Their discovery occurred in 1803 by Lewis and Clark while portaging around the Great Falls on the Missouri River. The flow of the springs has been measured at 160 cfs. The water is a constant temperature near 54°F (12°C) and of excellent water quality (Appendix A).

The Giant Springs State Fish Hatchery diverts approximately 15 to 18 cfs of Giant Springs for its operation. The hatchery was constructed in 1923 and considerable improvements have been made since the original development of the springs. The hatchery is a rearing facility and does not maintain a brood stock (Bob Hughes, pers. comm.). Eyed rainbow eggs are received from the Jocko River State Trout Hatchery. The trout planted from the hatchery range from 1.5 inches to 9 inches in length. The fry plants make up the majority of the production from Giant Springs.

The springs are the focal point of the Giant Springs State Park. They have been developed with bridges, walkways, and signs describing the springs.

TETON SPRING CREEK

Region: 4 Water Code:14-5760
Legal Description: Origin: T24N, R05W, Section 04A
Mouth: T24N, R04W, Section 33D
County: Teton

General Description

Teton Spring Creek flows in a southeasterly direction for approximately 9 miles before entering the Teton River south of Choteau at river mile 180.5. The spring flows entirely through private property. A 4.4 mile reach of the creek flows through a state designated bird preserve. Land uses inside and outside the preserve include cattle grazing and hay production. The creek's water is used extensively for irrigation during the summer months. The creek flows for 1 mile through the town of Choteau, its city park, and the rodeo grounds. Access is granted by permission on much of the creek.

Physical characteristics of the channel include a width range from 10 to 30 feet and a mean depth of 18 inches. Stream morphology is evenly divided between riffles, runs, and pools. Substrate composition is a mix of cobble and gravel free of fine sediment accumulation except in the pools. The mean water temperature for the month of July was recorded at 57^{o}F (13^{o}C). The USGS recorded a flow of 9.0 cfs in the 1970s. The riparian zone is in good condition above the town of Choteau but becomes degraded downstream of the town. Species composition include willow, alder, grasses, and forbs. An overhanging canopy is common in the upper reaches of the creek.

Habitat Trend and Limiting Factors

The fisheries habitat on Teton Spring Creek above the town of Choteau is in a static condition. Below town, however, conditions have deteriorated considerably. The creek has been channelized through town, trash is dumped in the creek, and woody species in the riparian zone are sparse. The entire channel, upstream and downstream of Choteau is badly dewatered during the growing season as a result of irrigation withdrawl.

Fisheries

Rainbow and brook trout have been surveyed in Teton Spring Creek (Hill and Phinney 1973, Hill and Poore 1974, Hill and Wipperman 1977 and 1983). Nongame species include white and longnose sucker, longnose dace, and sculpin species. Catchable rainbow trout have been planted in the city park in Choteau on an annual basis to provide for a children's fishery. Larger brown and rainbow trout surveyed in the creek seasonally indicate

spawning from the Teton River. No abundance estimate has been conducted on Teton Spring Creek.

Potential Value and Management Recommendations

Dewatering of the channel and habitat deterioration are probably the major limiting factors on Teton Spring Creek. A fisheries abundance survey and seasonal flow and temperature measurements should be conducted. An instream flow reservation should be filed on the creek. Other irrigation water sources should be developed. Fencing of the creek, the development of other irrigation water sources and cleaning up debris in the channel would greatly enhance the fisheries habitat of Teton Spring Creek.

BIG SPRING CREEK

Region: 4 Water Code: 16-0310
Legal Description: Origin: T17N, R16E, Section 26DD
Mouth: T15N, R19E, Section 07DC
County: Fergus

General Description

Big Spring Creek flows in a northwesterly direction for 30 miles before entering the Judith River at mile 72.3. Twenty-three tributaries in the drainage provide substantial amounts of nonspring water during spring runoff. The creek flows through the town of Lewistown approximately 9 miles below its origin. The entire drainage is in private ownership. Major land uses in the drainage include cattle and hay production, a timber milling operation, urban and rural development, and a state trout hatchery. The Big Spring State Hatchery is located in the headwater area, owning the source and a 76 cfs water right. Access is limited throughout the channel, particularly on the lower 11 miles. A 25 year lease on 1.5 miles of the lower creek was obtained in 1972 and the area was fenced.

The channel above Lewistown has a mean width and depth of 38 feet and 18 inches, respectively. Mean base flow discharge from 1969 to 1972 was 134 cfs. Several water quality parameters were measured in 1968 and 1969 (Marcoux 1969). The water above Lewistown was of high fertility and quality with seasonal increases in turbidity. Substrate composition ranges from sand to rubble with extensive mats of aquatic vegetation. Bank cover was in good condition and present along much of the bank. Species composition included water birch, hawthorne, willow, wild rose, grasses, and forbs. Banks were relatively stable and habitat in a relatively static condition.

Physical and chemical data were collected on Big Springs Creek below Lewistown. The mean width of the channel was 45 feet wide with a mean depth of 24 inches. Water temperatures collected during the summer 1968 ranged from 49 to 68^{o}F (9 to 20^{o}C) (Marcoux 1969). A USGS gauging station below Lewistown measured flows ranging from 124 to 1000 cfs. The base flow was 124-142 cfs. A 100 year flood event occurred in 1975 when flows measured at 2200 cfs. Total alkalinity and hardness, pH, and conductivity increased at the lower stations below Lewistown (Marcoux 1969). The riparian zone is in good condition above Cottonwood Creek, 10 miles above the mouth. The channel below Cottonwood Creek is in the most unstable condition. Considerable channel migration, sloughing banks, and greater sediment deposition characterize the channel. Because of this instability, the floodplain is undeveloped agriculturally.

Habitat Trend and Limiting Factors

Big Spring Creek has been plagued with continual problems throughout the last several decades. In 1961, 4200 feet of channel was bulldozed and straightened into a 2200 foot section to increase a landowner's hay land (Poore 1980). Extensive damage occurred downstream, costing nearly $1 million in public works project to correct. Considerable channel alterations have occurred through the town of Lewistown. The town's primary sewage treatment plant and a sawmill discharge their effluents into the creek. The removal of woody riparian species by permanent home owners above Lewistown have caused bank instability. Although the creek's water is used for irrigation, dewatering is not a concern.

Fisheries

Game species surveyed in Big Spring Creek above Lewistown are rainbow, brown, and brook trout and mountain whitefish. Nongame species include longnose and white sucker, carp, northern redhorse and mottled sculpin. Catchable rainbow trout were stocked annually in the creek prior to 1973 (Poore 1981).

A study, initiated in 1968, documented the changes in Big Spring Creek's wild trout population prior to fisheries management changes (Marcoux 1969 and Peterson 1970). Population monitoring occurred from 1968 to 1982 on several sections of creek (Poore 1983) and has continued on two long term monitoring sections on an annual basis since 1982 (Leathe and Hill 1987). An increase in all age classes of rainbow trout occurred over the 15 year period above Lewistown (Section B of Marcoux (1969), the Burleigh section). This increase probably resulted from the ceasing of stocking catchable rainbow trout in 1973. Data collected during 1986 indicated rainbow densities at that highest level on record primarily due to unusually high numbers of 10-15 inch fish (Table 1) (Leathe and Hill 1987).

The rainbow trout population below Lewistown (Section D of Marcoux (1969) (Tresch section) experienced a doubling of their numbers in the 15 year period. Most of this increase was in young-of-the-year trout. In 1986, densities of small rainbow (5-10 inch fish) were similar to past years while densities of medium-sized (10-15 inch) and large rainbow (greater than 15 inches) were somewhat lower than in past years. Total densities of 5-inch and greater rainbow during 1986 was over 3,000 fish per mile, which exceeded most previous estimates.

Brown trout numbers have remained the same from 1968 to the present in sections above and below Lewistown.

Table 1. Number of rainbow trout per mile by size group in the Tresch (Section D; downstream from Lewistown) and Burleigh (Section B; upstream from Lewistown) electrofishing sections on Big Spring Creek, 1979-1986 (Leathe and Hill 1987).

	Rainbow Trout per Mile				
Sample	5-10 inches	10-15 inches		>15 inches	
Year	Tresch	Tresch	Burleigh	Tresch	Burleigh
1986	1530	1547	1404	87	21
1984	1136	1918	692	234	34
1983	1487	2114	389	137	0
1982	----	----	428	---	30
1981	1666	867	330	245	23
1980	811	849	428	236	19
1979	506	549	172	22	4

Table 2. Number of brown trout per mile by size group in the Tresch and Burleigh electrofishing sections on Big Spring Creek, 1979-1986 (Leathe and Hill 1987).

	Brown Trout per Mile			
Sample	10-15 inches		>15 inches	
Year	Tresch	Burleigh	Tresch	Burleigh
1986	275	20	71	61
1984	288	20	125	39
1983	222	7	113	28
1982	---	7	---	60
1981	312	5	111	60
1980	339	5	121	79
1979	175	5	34	40

Potential Value and Management Recommendations

Big Spring Creek is a Class I trout stream with the highest trout biomass for a stream of this size in central Montana. Conservation easements or land acquisitions or leases should be investigated on the creek to insure preservation and public access. An instream flow reservation is being documented on Big Spring Creek to protect the DFWP water right.

WARM SPRINGS CREEK

Region: 4 Water Code: 16-3920
Legal Description: Origin: T16N, R20E, Section 05BD
Mouth: T18N, R16E, Section 08DB
County: Fergus

General Description

Warm Springs Creek, or Brooks Spring Creek, flows in a northwesterly direction for 45 miles before entering the Judith River. Warm Springs Creek originates on the northern slopes of the Judith Mountains. The flow in the creek above the springs is less than 4 cfs. The headwaters of the stream for this discussion will be considered at the springs located 8 miles above the mouth. The spring has a flow of 125 cfs, entering the creek from the north. Although there are 18 tributaries in the drainage, 95% of the flow originates from the springs annually (Phinney and Hill 1973). The drainage is privately owned by numerous landowners. Major land uses in the drainage are cattle grazing and hay production.

Physical and chemical data have been collected on the creek throughout the last several decades. Below the springs, the channel ranges in width from 35 to 50 feet. Flows measured by the USGS from 1966 to 1968 ranged from 123 to 270 cfs annually. Mean flow for 1968 was 136 cfs. Water temperatures in 1968 ranged from 40 to 78°F (4.4 to 25.5°C) from May to December (Baldes 1971). Temperature of the spring itself was near 68°F (20°C) during the period of record. The gradient is relatively steep for the upper 5 miles below the springs. The stream morphology is a run/riffle/pool sequence. The riparian zone is in good condition in the upper reaches. Species composition in the riparian zone include chockcherry, hawthorne, willow, water birch, grasses, and forbs. Gravels are clean and fines have accumulated in the slower runs and pools.

Fish habitat deteriorates substantially in the lower 5 miles of the creek. Banks are eroding and much of the stream bank is open. Gradient decreases and fines have accumulated over much of the substrate. Aquatic vegetation is dense in the channel during the summer months.

In 1988, a California fish farming group proposed a white sturgeon farm on Warm Springs Creek. Plans have been temporarily delayed due to disease problems in their farms in California. Questions also have been raised concerning the impact of a white sturgeon fish farm and possible escapement on the native pallid sturgeon in the Missouri River. The pallid is being considered as a federally threatened and endangered species.

Habitat Trend and Limiting Factors

The fisheries habitat of the lower 5 miles of Warm Springs Creek has deteriorated as a result of agricultural abuse. Excessive siltation, bank sloughing, and loss of riparian habitat have contributed to this deterioration. The water temperature limits trout production.

Fisheries

Fisheries in Warm Springs Creek has been surveyed in the 5 mile section below the springs. Game species surveyed include rainbow trout, sauger, channel catfish, brook trout, smallmouth bass, and goldeye. Nongame species include carp, longnose, white and mountain sucker, longnose dace, shorthead redhorse, mottled sculpin, and fathead minnow (Micheal Poore, pers. comm.).

The temperature of Warms Springs Creek is near 68°F (20°C) annually. Because this temperature is near the tolerance level for salmonid species, natural reproduction is limited. The creek has been planted with rainbow trout annually since the 1950s. Currently, 7500 catchable rainbow trout are stocked annually below the springs. Brown trout were planted in 1953 and 1954. In 1973, experimental smallmouth bass fry plants were initiated and continued to 1977. Although smallmouth bass have been reported in the angler's creel, few have been captured using electrofishing (Poore 1984). All age classes of smallmouth bass have been captured, however, indicating natural reproduction.

Potential Value and Management Recommendations

Warm Springs Creek is a unique ecosystem found in the arid portion of central Montana. A well developed fishery fails to develop in the creek, probably as a result of the warm water temperatures. Investigations should continue to determine a species complex that would thrive in the creek's habitat below the springs.

The creek has been abused by agricultural practices and its fishery habitat continues to deteriorate. An instream flow reservation should be filed on the creek to prevent any major new diversions such as the hydroelectric facility proposed in 1981. Conservation easements should be acquired and land acquisitions for access should be investigated. Fencing of the lower 5 miles would greatly increase the riparian and instream habitat.

UPPER

YELLOWSTONE RIVER DRAINAGE

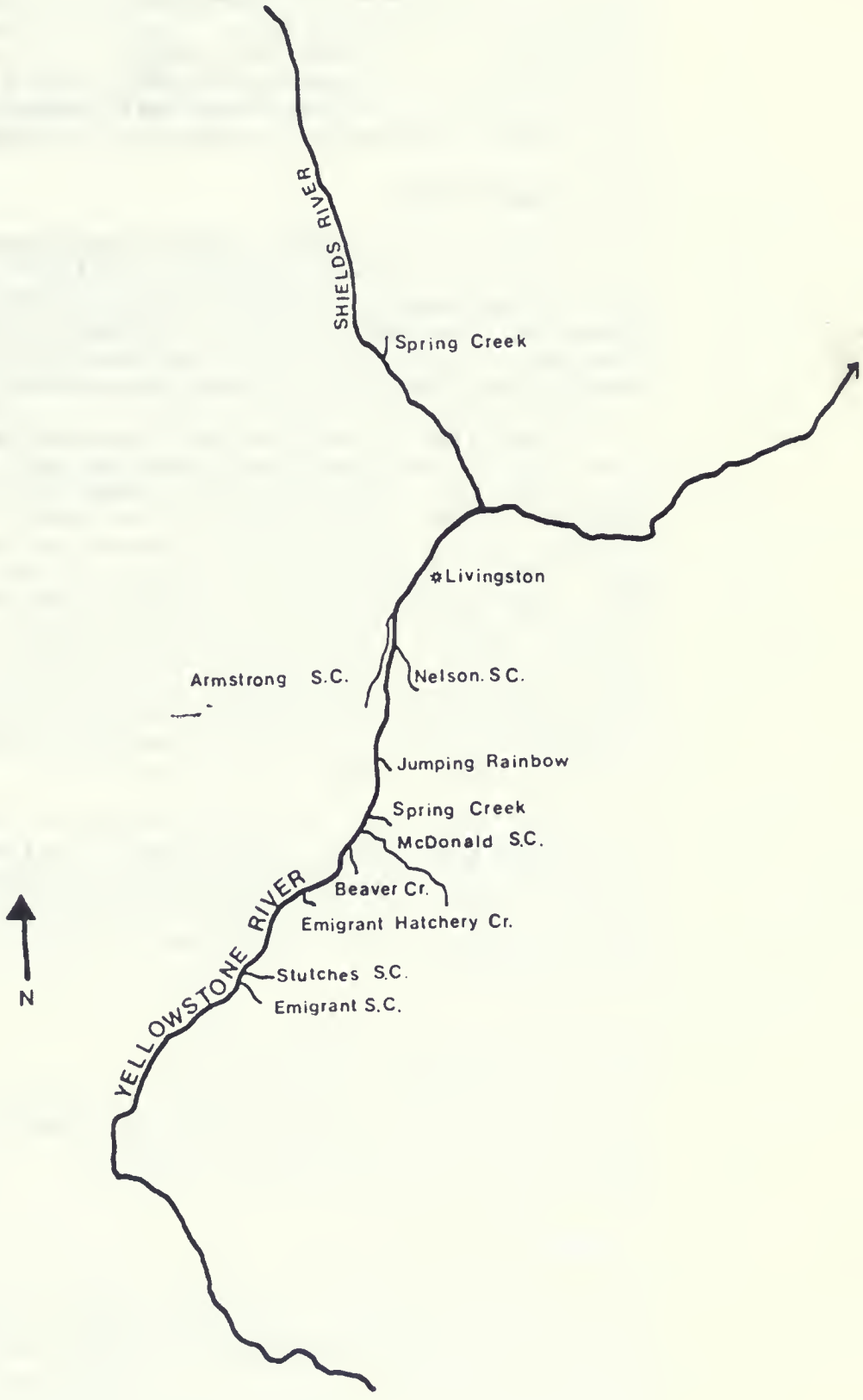


Figure 10. Upper Yellowstone River drainage map.

EMIGRANT SPRING CREEK

Region: 3 Water Code: 22-2368
Legal Description: Origin: T06S, R08E, Section 09DD
Mouth: T06S, R08E, Section 09BB

General Description

Emigrant Spring Creek flows in a northwesterly direction for less than 1 mile before entering the Yellowstone River at mile 528.4. Two ranches own the creek and fishing is allowed by permission. The majority of the channel was artificially made in order to drain low meadow areas for agricultural use. The creek is used for stock watering and irrigation of hay fields.

Three distinct habitats are apparent in Emigrant Spring Creek. Beaver dams have created extensive pool development in the upper section. Over 75% of the banks are covered by woody species. In the middle portion of the creek, the gradient slows and fines have covered the gravel/cobble substrate in the shallow pools. Woody species have decreased to cover only 20% of the banks. The lower section is 4 to 8 feet wide with a mean depth of 6 inches. Riffles dominate the section with a clean substrate of cobble and gravel. Less then 5% of the riparian vegetation are woody species. Grazing in the lower section has accounted for open banks. In 1986, the lower 300 yards of the creek were fenced to protect spawning trout by the Joe Brooks Chapter of the Trout Unlimited (Chris Clancy, pers. comm.).

Chemical and physical data have been collected sporadically on Emigrant Spring Creek. Water quality data were found to be of high fertility and quality (Berg 1975). The range of values were similar to that found in Armstrong and Nelson Spring creeks. Water temperatures in 1984 ranged from 37 to 56°F (3 to 11°C) (Clancy 1985).

Habitat Trend and Limiting Factors

Fencing of the lower section has improved bank cover and narrowed the channel. The beaver dams in the upper section reduce trout habitat and block spawning access.

Fisheries

Resident game species in Emigrant Spring Creek include brown, brook, rainbow, and Yellowstone cutthroat trout and mountain whitefish. Mottled sculpin have been the only nongame species surveyed. A 500 foot section near the mouth was electrofished in 1974. The survey found 58 brown trout with a mean length of 8.7 inches, 3 brook trout ranging in length from 6.8 to 12.5 inches, and 8 mountain whitefish with a mean length

of 4.5 inches (Berg 1975). Yellowstone River brown, rainbow, and Yellowstone cutthroat trout have been reported spawning in the creek (Berg 1975 and Clancy 1985). Although Berg (1975) reported Yellowstone cutthroat trout spawning in Emigrant Spring Creek in 1974, Clancy (1984 and 1985) found no occurrence. In 1986 and 1987, 17,000 and 13,000 Yellowstone cutthroat trout eggs were planted, respectively, in the lower reaches to establish a spawning run.

Potential Value and Management Recommendations

With the fencing of the major spawning gravels and the egg plants, the potential of Emigrant Spring Creek to the Yellowstone main stem has probably been met. The only other management recommendation would be to remove beaver dams in the upper section to improve trout habitat. An instream flow reservation was filed on Emigrant Spring Creek with a priority date of December, 1978. The USGS is currently quantifying the reservation.

STUTCHES SPRING CREEK

Region: 3	Water Code: 22-6157
Legal Description:	Origin: T06S, R08E, Section 9BAC
	Mouth: T06S, R08E, Section 4CD

General Description

Stutches Spring Creek flows in a northwesterly direction for less than one mile before entering the Yellowstone River at river mile 528.9. The creek has changed ownership several times in recent years and is currently owned by one landowner. Ponds have been built on the upper creek and the flow of a smaller spring creek was diverted into Stutches to increase its flow.

Limited physical and chemical measurements have been collected on Stutches Spring Creek. A flow of 5.0 cfs was measured in March, 1982 (Chris Clancy, pers. comm.). Channel width ranges from 6 to 10 feet with a mean depth of 6 inches. The channel consists of 20% pools, 60% runs, and 20% riffles. Substrate in the upper channel is a cobble/gravel mixture with small quantities of fines. The gradient decreases in the lower section and fines have been deposited over 50% of the channel. The riparian zone consists of forbs, grasses, rose, and willow. Water temperatures ranged from 38 to 48°F (3 to 9°C) during fall, 1984 and 42 to 64°F (6 to 18°C) during the summer of 1985 (Chris Clancy, pers. comm.).

Habitat Trend and Limiting Factors

In 1982, a stream rehabilitation consulting firm built habitat improvement structures, brought in gravel, and built pools in Stutches Spring Creek. As a result, the overall habitat trend of the creek improved. Habitat changes resulting from the flow augmentation and ponds built on the stream in 1986 have not been documented. The creek is affected by high water during spring runoff from the main river.

Fisheries

Game species in Stutches Spring Creek in order of abundance are brook trout, brown trout, mountain whitefish, rainbow trout, and Yellowstone cutthroat trout. Yellowstone River brown trout and Yellowstone cutthroat trout spawn in the creek (Clancy 1985). A small, yet significant run of Yellowstone cutthroat trout were documented in 1985 (Clancy 1987).

Potential Value and Management Recommendations

Changes in habitat and fisheries populations should be monitored in Stutches Spring Creek to document results of habitat and flow improvements.

EMIGRANT HATCHERY SPRING CREEK

Spring water flowing from T05S, R08E Section 08 has historically been used for hatchery trout production. In 1924, the State of Montana constructed and operated a fish hatchery at Emigrant. In 1950s, the State closed the hatchery because the waters were too cold for efficient egg production. The water rights to the spring and the land was bought by a subsidiary of the Jumping Rainbow Ranch. Commercial rainbow trout production occurred for several years in the early 1980s. The existing channel, .5 miles in length, connects the hatchery ponds to the Yellowstone River. The gradient is slow and the channel is filled with fine sediment. The banks are slumped and eroded as a result of livestock grazing.

The hatchery filed for bankruptcy and the land was acquired by an absentee landowner from Texas. In 1988, the hatchery again began commercial production of rainbow trout.

TANA RANCH
SPRING CREEK COMPLEX

Spring Creek
Region: 3 — Water Code: NA
Origin: T04S, R09E, Section 09AA
Mouth: T04S, R09E, Section 09BC

McDonald Spring Creek
Region: 3 — Water Code: 22-3930
Legal Description: Origin: T04S, R10E, Section 16AA
Mouth: T04S, R09E, Section 09CC
County: Park

Beaver Creek
Region: 3 — Water Code: 22-0399
Legal Description: Origin: T04S, R09E, Section 23DC
Mouth: T04S, R09E, Section 15AC
County: Park

General Description

Three spring creeks flow through the Tana Ranch located on the east bank of the Yellowstone River. The 900 acre ranch also includes three miles of the river. The ranch is owned by Rembrant Enterprises of Minnesota. The property includes 450 acres of subirrigated lands and 450 acres of upland pasture. The spring creeks are used for stock watering and irrigation.

McDonald Creek flows in a northwesterly direction for 4.4 miles before entering the Yellowstone River at river mile 509.4. The creek originates on Forest Service land and receives surface flow seasonally. Remnants of diversion structures remained in the channel until a rehabilitation project in 1988. Instream structures were constructed to improve fisheries habitat, stream banks were fenced, and riparian areas were seeded (Chris Clancy, pers. comm.). A flow of 14.4 cfs was measured by the USGS in 1985. Substrate composition was 100% fines except in the riffles where the substrate is a clean cobble/gravel mixture. Additional clean gravel has resulted from the instream structures placed in 1988. The water in McDonald Creek is less productive than either Nelson or Armstrong Spring Creeks in the Yellowstone Valley (Berg 1975). Brush, undercut banks, and debris measurements were calculated at 217 ft^2 of bank cover per 1,000 ft^2 of bank (Berg 1975). This was the lowest bank cover of 10 streams surveyed in the Yellowstone Valley. Brush had the lowest quantity of the three parameters measured.

Water in Spring and Beaver creeks originates from springs located on the Tana Ranch. Spring Creek is less than .5 mile in length. Beaver Creek, south of McDonald Creek, flows in a westerly direction for less than 1 mile before entering the Yellowstone River. Flows measured by the USGS in 1985 in Spring and Beaver creeks were 5.7 and 17.9 cfs, respectively. Channel

morphology is limited to runs with a small percentages of pools and riffles. Considerable aquatic macrophytic growth occurs in the channel. Most exposed gravels were armored. Beaver Creek's substrate is gravel/cobble with over half of the bottom covered by a fine layer of silt. No water quality data were collected on Spring or Beaver creeks. The riparian zones consist of willows, grasses, and forbs. Riparian cover on Beaver and Spring creeks appeared of higher quality than McDonald Creek (Berg 1975).

Habitat Trend and Limiting Factors

The spring creeks on the Tana Ranch have deteriorated from agricultural practices. Stream channels have been widened and depths have been reduced. Bank trampling has caused a loss of bank cover, substrates have been compacted, and pools have been filled by fine silts. The rehabilitation project have improved habitat on the lower portion of McDonald Creek.

Fisheries

Rainbow, brown, and Yellowstone cutthroat trout and mountain whitefish are resident game species in McDonald Creek. Nongame species include mottled sculpin. Brown trout are the dominant game species. Yellowstone River brown, rainbow, and Yellowstone cutthroat trout spawn in the creek (Berg 1975 and Clancy 1985). Spawning runs in McDonald Creek by Yellowstone cutthroat trout were documented in 1985 and 1986 (Clancy 1987). Clancy feels the small run could be substantially improved. Spawner use has not been documented since the stream improvements of 1988.

Population estimates were calculated for brown trout in McDonald Creek using a mark and recapture method in 1975 and 1984 (Berg 1975 and Clancy 1985). The brown trout population showed a decline over the 10 year period. Total numbers from July, 1975 to September, 1984, were reduced by approximately one half (Table 1). Habitat deterioration was considered the major reason for this decline.

No fisheries data have been collected on Spring or Beaver creeks. The streams have been walked during various spawning periods and no fish have been observed (Chris Clancy, pers. comm.).

Table 1. Population estimates of brown trout in 1974 and 1984 in McDonald Creek. Estimates were made for a 1,000 ft section. Totals include trout <6.0" (Berg 1975 and Clancy 1985).

Year	6-11.9"	>12.0"	Total
July, 1975	171	21	288
Sept., 1984	103	10	113

Potential Value and Management Recommendations

Fencing of the other spring creeks would protect the streams from livestock grazing. A fisheries and habitat survey should be conducted on Spring and Beaver creeks to document current conditions. An instream flow reservation was filed on the three creeks with a priority date of December, 1978. The USGS has quantifying the reservation (Fred Nelson, pers. comm.).

JUMPING RAINBOW RANCH SPRING CREEK

Region: 3 Water Code: NA
Legal Description: Origin: T03S, R09E, Section 35 DD
Mouth: T03S, R09E, Section 35 DD
County: Park

General Description

Jumping Rainbow Ranch Spring Creek flows in a northwesterly direction for approximately 1 mile before entering the Yellowstone River at river mile 506.7. In the early 1970s, 15 ponds were constructed on the creek for the commercial production of rainbow trout. In 1984, John Sullivan bought the ranch containing the creek to develop a planned residential community. A stream rehabilitation consulting firm constructed a new stream channel which connected with several of the abandoned lower hatchery ponds (Joe Urbani, pers. comm.) Some of the other ponds were converted into spawning channels for the river (O'Brien 1986). As of 1989, one lot had been sold in the subdivision.

The reconstructed channel is approximately 4 to 10 feet wide with a mean depth of 6 inches and a flow of approximately 5 cfs. A riparian zone of alfalfa, grasses, and willows was planted. Permission to fish Jumping Rainbow will be restricted to landowners in the subdivision.

Habitat Trend and Limiting Factors

The fisheries potential of Jumping Rainbow Ranch Spring Creek has improved considerably since the reconstruction occurred in 1985. Prior to the reconstruction, flows from the springs were diverted completely into the series of ponds for the commercial trout production.

Fisheries

Brook trout were the only game species surveyed in the reconstructed channel (Urbani and Miller 1984). Plans are to stock brown trout in the channel and rainbow trout in the ponds. Longnose and white sucker are the nongame species that have been inventoried. Since the opening of the channel to the Yellowstone River, brown trout were observed spawning in 1985 (Joe Urbani, pers. comm.). Plans also include stocking Yellowstone cutthroat trout in the channel if the last pond is removed to encourage further spawning (Chris Clancy, pers. comm.).

Potential Value and Management Recommendations

As a result of the newly constructed channel and plans for the fishery, no further recommendations would be made at this time. Resident and spawning habitat for trout have been expanded as a result of this work. The populations should continue to be monitored.

ARMSTRONG SPRING CREEK

Region: 3 Water Code: 22-0140
Legal Description: Origin: T03S, R09E, Section 26 BC
Mouth: T03S, R09E, Section 23 CD
County: Park

General Description

Armstrong Spring Creek parallels the Yellowstone River for nearly 1 mile before entering the river at mile 504.4 south of Livingston. Armstrong Spring Creek is nationally acclaimed for its outstanding trout fishery and its unique spring creek habitat.

The springs and its channel are located on Alan O'Hair's property. Grazing, hay production, and fee fishing are the major use activities of the creek and its adjacent land. A portion of the creek was diverted for commercial trout production until 1981. From 1969 through 1974, the Joe Brook Chapter of Trout Unlimited leased the fishing rights. Today, a trespass fee is charged to the angling public.

Physical and chemical data have been collected on the creek since the early 1970s. Channel width varies along the length of the creek, ranging from 30 to 65 feet. A flow of 102 cfs was measured by the USGS in June, 1985. Temperatures were measured during the spring and fall of 1984 and ranged from 44 to 56^{o}F (7 to 13^{o}C) (Chris Clancy, pers. comm.). Water quality is excellent and high in chemical fertility (Berg 1975). Riparian condition is good, composed of willow, alder, grasses, rose, and forbs.

Habitat Trend and Limiting Factors

The fisheries habitat in Armstrong Spring Creek remains in a static condition. Bank trampling by cattle is evident and excessive in some areas. Fencing occurred on a small portion of the creek in 1988.

Fisheries

Game species present in Armstrong Spring Creek include rainbow, brown, and Yellowstone cutthroat trout and mountain whitefish. Nongame species include mottled sculpin. The creek is considered substantial habitat for a Montana species of special concern, the Yellowstone cutthroat.

A fisheries population study was begun in 1969 when Trout Unlimited acquired a five year use lease (Berg 1975). Additional data were collected when raceways were constructed on the stream in 1974 and again in 1977 when additional raceways were proposed

(Stevenson 1980). A significant change in the population dynamics of Armstrong Spring Creek occurred when the commercial rainbow trout hatchery was constructed (Stevenson 1980). Wild brown trout were the dominant species in 1971 and 1972, (77 and 84%, respectively) (Table 1). By the spring of 1978, 73% of the population were rainbow trout and 27% were brown trout. Nearly half of all the rainbow trout captured were of hatchery origin. Angler creel from DFWP fisherman logs reflect a similar change in species composition beginning in 1976. Rainbow remained the dominant species in the catch through the 1984 fishing season. Commercial trout are no longer being produced on O'Hair's property.

Table 1. Spring population estimates of trout 6.0 inches and larger per 1,000 ft in Armstrong Spring Creek (80 percent confidence limits are in parentheses) (Stevenson 1980).

Species	Length Group (inches)				
	6.0-9.9	10.0-13.9	14.0-17.9	18.0+	Total
		1971			
Rainbow Trout	117	219	31	1	368(±97)
Brown Trout	680	449	76	4	1,209(±85)
Total	797	668	107	5	1,577(±182)
		1972			
Rainbow Trout	29	131	29	1	190(±28)
Brown Trout	516	448	34	4	1,002(±144)
Total	545	579	63	5	1,192(±172)
		1978			
Rainbow Trout	267	601	231	0	1,009(±346)
Brown Trout	64	228	112	0	404(±75)
Total	331	829	343	0	1,413(±421)

Potential Value and Management Recommendations

Armstrong Spring Creek is nationally famous for its outstanding fishery and habitat values. Because of this recognition, it deserves the highest habitat protection to allow for maximum fisheries potential. An instream flow reservation was filed on the creek with a priority date of December, 1978. The USGS quantified the reservation in 1986 (Fred Nelson, pers. comm.). The creek should be fenced entirely from livestock. A fish abundance estimate should be conducted on the creek to document population changes following commercial hatchery trout production ceasing in 1981.

DEPUY'S SPRING CREEK

Region: 3 Water Code: 22-0140
Legal Description: Origin: T03S, R09E, Section 23 CD
Mouth: T03S, R09E, Section 23
County: Park

General Description

DePuy's Spring Creek parallels the Yellowstone River for 3.5 miles before entering the river at mile 502.2 south of Livingston. The history of DePuy's Spring Creek is filled with controversy and public outcry. Recently, as a result of efforts by the landowner and a private individual, DePuy's Spring Creek is beginning to reach its fisheries potential.

In 1959, Warren DePuy, the landowner below Armstrong Spring Creek, diverted the creek into a 3.5 mile channel across his property. A dam was constructed across the mouth of Armstrong Spring Creek blocking all upstream migration by trout from the Yellowstone River. The new channel on DePuy's property included a series of ponds constructed for commercial trout production.

Robert Auger, a fishing guide and landowner in the Paradise Valley, had been serving as the "river keeper" for the spring creek since 1985. A fishing fee of $30.00 per day was established by DePuy in 1982. A limit of 15 rods per day were allowed on the creek. Fly fishing only and catch and release only were the angling restrictions on the creek. Reservations were declining on DePuy's Spring Creek while being taken years in advance on Nelson and Armstrong Spring creeks. Auger approached the DePuys in 1985 with a rehabilitation plan for the spring creek. He felt that a declining fishery caused by poor habitat contributed to the low numbers in reservations.

The rehabilitation plan divided the spring creek into 14 sections. Extensive habitat improvements were made to the entire creek. Two miles of the creek were fenced including stock watering access, banks were seeded, and the hatchery ponds were removed. Other improvements included removing 3/4 mile of barbed wire in the creek, the removal of another dam that had silted in 1/4 to 1/2 mile of creek, and the planting of 3,000 willows along the stream to improve the riparian zone. A new culvert was installed at the mouth to allow access to the creek. The dam diverting Armstrong's Spring Creek into the DePuy channel was rebuilt with a fish ladder to provide spawning access.

The rehabilitation projects have been funded by the DePuys, the MDFWP, Montana Trout Foundation, Joe Brooks Trout Unlimited, and a grant to continue the rehabilitation has recently been proposed to the National Trout Unlimited.

Habitat Trend and Limiting Factors

The fisheries habitat of DePuy's Spring Creek has improved substantially since the inventory in 1985. The habitat improvements, fencing, dam removal, and culvert installation has created 3 miles of spring creek and spawning habitat for Yellowstone River trout that previously did not exist.

Fisheries

Yellowstone River populations of brown, rainbow, and Yellowstone cutthroat have been documented using the spring channels on DePuy's property prior to the rehabilitation project. The spawning potential of the creek was not being met due to access problems and the slowed velocities found in the channels. Since habitat improvements and increased access to the creek, Yellowstone cutthroat redd counts have increased from 19 in 1986 to 93 in 1988 (Robert Auger, pers. comm.). Use by spawning rainbow trout from the Yellowstone River was documented in 1985 and 1986 (Clancy 1987). A total of 325 and 161 males were recorded in 1985 and 1986, respectively. Female totals were 123 and 68 in 1985 and 1986, respectively. Spawning was earlier than main stem spawning. It was concluded that early spawning may aid in survival (Clancy 1987). Based on tag returns, main stem rainbow trout moved up and downstream to spawn in the creek.

The resident fisheries population in DePuy's Spring Creek was estimated in October, 1988 (Chris Clancy, pers. comm.) A total of 1,214 trout were estimated in a 3,000 foot section. Rainbow trout contributed over 75% of the trout. Total length range for both trout species were 11-24 inches with the majority 13-16 inches. Mountain whitefish was the other game species present. Nongame species included longnose sucker, white sucker, carp, sculpin sp., and mountain sucker.

Potential Value and Management Recommendations

The improvements made to DePuy's Spring Creek should greatly increase the resident fishery as well as the main stem population which use the creek. Access and use of 3 additional miles in DePuy's Spring Creek and reopened access to Armstrong Spring Creek could significantly enhance main stem trout populations. An instream flow reservation should be filed on the creek. The resident fish populations and spawner use should be documented and monitored.

NELSON SPRING CREEK

Region: 3 Water Code: 22-4305
Legal Description: Origin: T03S, R09E, Section 26DC
Mouth: T03S, R09E, Section 23CA
County: Park

General Description

Nelson Spring Creek flows in a northwesterly direction for approximately 2 miles before entering the Yellowstone River at river mile 505.5 south of Livingston. There are two landowners on Nelson Spring Creek. Bill Dana owns the mouth and the headwater areas, totaling 1.7 miles. Land use on his property includes cattle grazing and hay production. Water is withdrawn from two large irrigation diversions on the lower property. The lower creek was fenced in 1988. Dana donated a conservation easement to Trout Unlimited in 1980 prohibiting all non-agricultural uses of the ranch. The easement was transferred to the Montana Land Reliance in 1986 and an additional easement was donated at the time of the transfer. The easement includes .5 miles of the spring creek, 3 miles of the Yellowstone River, and 1,600 acres. Access to the stream is restricted and generally limited to family and friends of the Dana's.

Edwin Nelson owns the middle .5 miles of Nelson Spring Creek. Creek waters are used for irrigation, stock water, commercial trout production, and recreational fishing. Livestock is fenced from the creek during the summer months except for the lower 75 yards. A fee of $30.00 per day is charged to fish on the Nelson property. A limit of 6 rods per day has been placed on the creek by the landowner. Full booking occurs during the months of June through September. Rainbow trout, used for pond stocking, are raised in raceways off the spring creek. The raceways are feed by smaller springs and diverted spring creek water. The raceways drain into the creek, allowing escape of the hatchery rainbow to the spring creek.

Physical characteristics on Nelson Spring Creek have been collected during various fisheries studies. The channel width ranges from 25 to 60 feet with a mean depth of 14 inches. The flow has been estimated at 40-50 cfs. Water temperatures were recorded during 1984 from March to November and ranged from 44 to 65^{o}F (7 to 18^{o}C). The substrate is clean and composed of gravel, cobble, and fines. Aquatic plants cover over 50% of the bottom during the summer months. Water chemistry measured in 1974 indicated high water quality and productivity (Berg 1975). Riparian condition is very good with only a few areas of slumping, indicating cattle use. Species composition consists of forbs, sedges, grasses, willow and alder.

As a result of the stream access law passed in 1985, both landowners submitted a petition requesting Nelson Spring Creek be closed to the fishing public. Reasons for the closure

included..."because of the potential for damage to its....fragile ecosystem including its irreplacable role as a spawning ground for Yellowstone River trout". The petition was denied by the Montana Fish and Game Commission but studies were initiated to quantify the effects of fisherman and stock trampling on developing eggs in the gravels and recreational use of the creek (Allen and Duffield Roberts and White 1986, and MDFWP 1986). As a result of the studies, the Commission changed the regulations on Nelson Spring Creek to catch and release fishing using artificial flies and lures and wading was banned on the Dana property and portions of the Nelson property from June 1 to September 15. Both measures were adopted to protect cutthroat trout spawning and increase egg and fry survival.

Habitat Trend and Limiting Factors

The fisheries habitat in Nelson Spring Creek is in a static condition. The recent fencing on the lower Dana property should prevent further stock damage to the banks. Escaping rainbow trout from the raceways on the Nelson property potentially could change the trout population dynamics.

Fisheries

Yellowstone River populations of Yellowstone cutthroat, brown, and rainbow trout spawn in Nelson Spring Creek. The creek is one of the few spawning tributaries that is used by the Yellowstone cutthroat (Clancy 1984 and 1987). Yellowstone cutthroat move into the creek in early June and spawn through mid-July (Clancy 1987). The creek is also considered a key spawning area for Yellowstone River rainbow trout. A total of 86 males and 58 females were counted in the creek in 1986 (Clancy 1987).

Rainbow and brown trout are the resident game species found in Nelson Spring Creek. Resident fisheries population data have not been extensively collected on the creek.

Potential Value and Management Recommendations

The remaining unfenced banks of Nelson Spring Creek should be fenced from livestock use. The raceways should be securely screened to prevent hatchery rainbow trout escape into the spring creek. The effect of their introduction on the wild trout resident population in the creek is unknown. The introduction of hatchery trout to the creek may be depressing the wild trout stock (Vincent 1985).

An instream flow reservation was filed on Nelson Spring Creek with a priority date of December, 1978. The USGS is currently quantifying the reservation (F. Nelson, pers. comm.).

SHIELDS RIVER SPRING CREEK

Region: 3 Water Code: 22-5940
Legal Description: Origin: T N, R E, Section
Mouth: T01N, R09E, Section 14

General Description

Shields River Spring Creek enters the Shields River at river mile 16.8 after flowing in a southeasterly direction for approximately 1 mile. The Shields River enters the Yellowstone River at mile 489.0. One landowner owns the entire stream and access is granted by permission or by use of the highway right-of-way. Considerable channel alteration was completed in 1985 resulting from the reconstruction of Montana Highway 89. An increase in stream length, additional meanders creating pools, larger culverts allowing fish passage, gravel placement, and small drop structures were included in the reconstruction (Ralph Boland, pers. comm.). The spring creek is used for stock water and irrigation and cattle graze in the riparian zone.

Physical data on the creek are limited to observations at the time of the site visit in July, 1985. A flow of 1 to 2 cfs was estimated. Channel width ranges from 5 to 10 feet with a mean depth of 10 inches. Substrate composition consists of a gravel and cobble mixture covered by silt and aquatic macrophytes. Gravel is located in areas of steepest gradient and water velocity. The riparian zone is recovering from the reconstruction activities and presently consists of grasses and forbs. There are currently no woody species in the riparian zone.

Habitat Trend and Limiting Factors

The fisheries habitat of Shields River Spring Creek is currently improving as a result of the reconstruction project. The creek is limited because of its size and current land use in the drainage.

Fisheries

Game species surveyed in Shields River Spring Creek include brown and Yellowstone cutthroat trout and mountain whitefish. Mottled sculpin was the only nongame species inventoried. Electrofishing surveys were conducted in 1976 and 1978 near the mouth (Region 3 files). Brown trout were the most common trout collected with smaller numbers of Yellowstone cutthroat and brook trout. One large brown trout over 18 inches was captured in November. This was assumed to a spawner from the Shields River.

Potential Value and Management Recommendations

Considerable habitat improvement occurred as a result of the recent highway reconstruction. Because of present land use and the small size of this spring creek, no further management recommendations would be made.

LOWER

YELLOWSTONE RIVER DRAINAGE

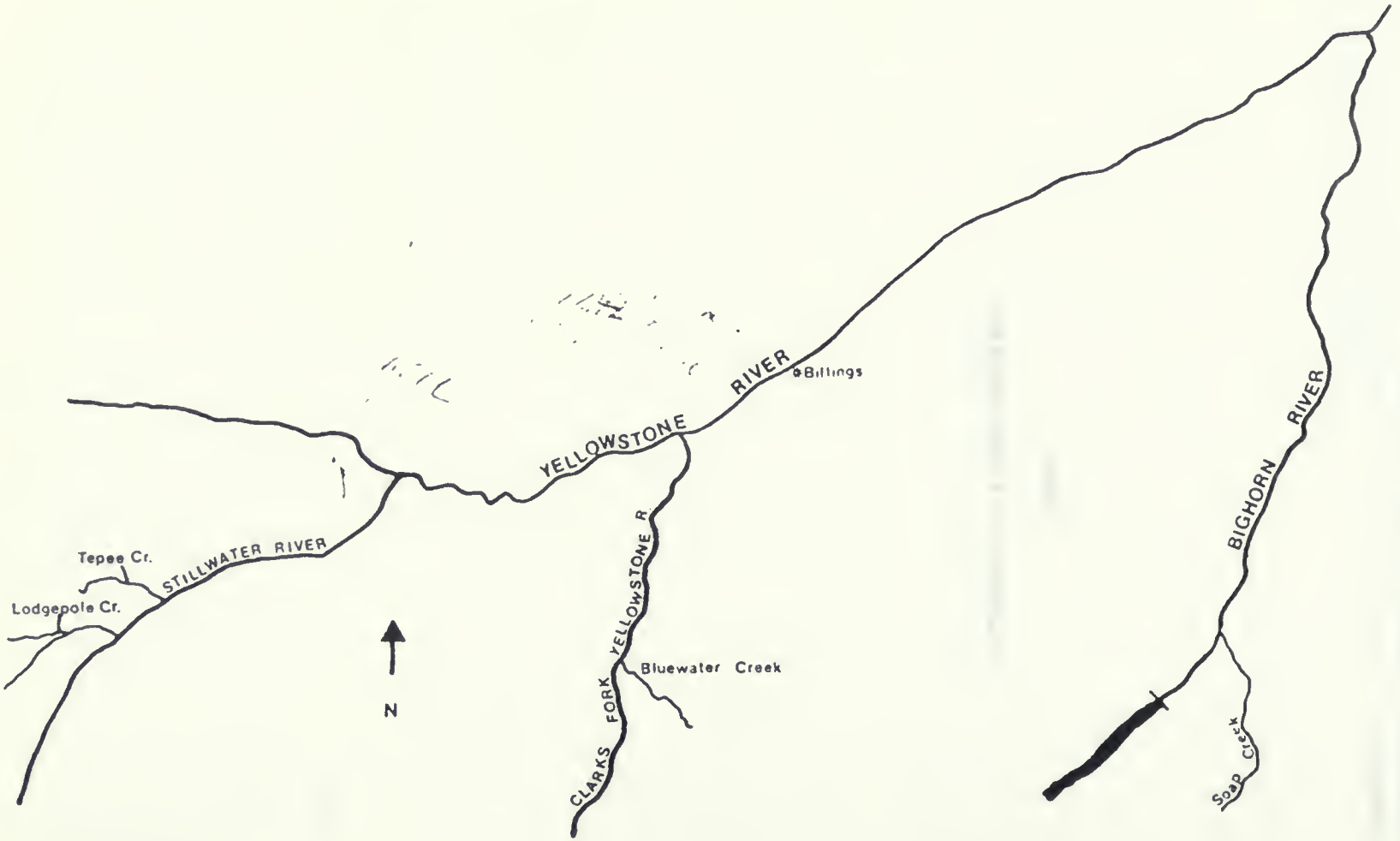


Figure 11. Lower Yellowstone River draiange.

LODGEPOLE CREEK

Region: 5	Water Code: 22-3808
Legal Description:	Origin: T04S, R15E, Section 06C
	Mouth: T04S, R15E, Section 20A
	County: Stillwater

General Description

Lodgepole Creek originates in the Pryor Mountains, flowing in a southeasterly direction for 3.5 miles before entering Castle Creek, a tributary to the West Fork Stillwater River. The spring originates from limestone cliffs in the foothills of the Pryor Mountains. The creek is privately owned by three landowners. Access is granted by landowner permission. Major land uses in the drainage are cattle grazing and hay production. Water from Lodgepole Creek is used for irrigation and stock watering with irrigation return water flowing back into the creek.

Limited physical and chemical data have been collected on Lodgepole Creek. Mean width of the channel is 6 feet with a mean depth of 6 inches. Water temperature was measured at 50°F (10°C) during the summer of 1975 (Marcuson 1976). Water quality is excellent and increases in fertility in a downstream direction (Marcuson 1976). The riparian zone is composed of willow, grasses, and forbs. Stock trampling has damaged the riparian zone throughout the drainage.

Lodgepole Creek's fishery was considered one of the best in the area in 1975 (Marcuson 1976). Game species include brook trout in the upper reaches and brown, rainbow and, brook trout in the lower reaches. No abundance estimates have been conducted.

TEPEE CREEK

Region: 5 Water Code: 22-6262
Legal Description: Origin: T03S, R15E, Section 34D
Mouth: T04S, R15E, Section 02C
County: Stillwater

General Description

Tepee Creek originates in the Pryor Mountains of southeastern Montana. It flows in a southerly direction for 1.4 miles before entering Bad Canyon Creek, a tributary to the Stillwater River. The creek is located entirely on the Custer National Forest. Cattle grazing and recreation are the major land uses in the drainage. Tepee Creek contributes water volume and nutrients to downstream waters, enhances fish food production, and is used as a spawning tributary (Marcuson 1976).

Limited physical and chemical data have been collected on Tepee Creek. Mean channel width is 4 feet with a mean depth of 5 inches. A water temperature of 55°F (13°C) was recorded in 1980 (MBMG 1981). Water quality is considered excellent, containing moderate levels of dissolved nutrients (Marcuson 1976).

Yellowstone cutthroat trout have been the only game fish surveyed in Tepee Creek (Marcuson 1976). No abundance surveys have been conducted.

BLUEWATER SPRING CREEK

Region: 5 Water Code: 22-0714
Legal Description: Origin: T06S, R24E, Sections 09AD & 04DD
Mouth: T05S, R23E, Section 21B
County: Carbon

General Description

Bluewater Spring Creek flows in a westerly direction for 17.5 miles before entering the Clarks Fork of the Yellowstone River at river mile 32.4 near Fromberg. There are 4 tributaries in the drainage including its north and south forks. Three landowners in the drainage, including the DFWP, use the creek for domestic water, irrigation, stock water, and trout production. The Bluewater Trout Hatchery is located at river mile 12. The hatchery was built in 1947 and currently raises 800,000 to 1,000,000 rainbow trout annually (Tom Morgan, pers. comm.). Below the hatchery, the canyon opens up and the creek meanders through a wide prairie valley of hay meadows, orchards, and cattle pastures.

A unique terrestrial ecosystem has developed in the canyon headwaters at the spring source. One rare terrestrial plant, 2 regional endemics, and 2 southern species at their northern limits are located in the drainage (Nature Conservancy files).

Physical and chemical data were collected on Bluewater Spring Creek during a DFWP study in the 1970s (Marcuson 1979). Channel width measured 11 feet above the hatchery and 15 feet near the mouth. Flows measured by the USGS and the DFWP increased from 10.5 cfs above the major springs to 41.6 cfs near the mouth. Below the hatchery, mean annual flow varied between 27-32 cfs. Flows in the lower reaches are reduced considerably due to extensive irrigation withdrawls. Mean annual suspended sediment levels increased from 25 ppm to 437 ppm between the upper to lower reaches. Water temperatures below the hatchery ranged from 34 to 70°F (1 to 21°C). Temperature of the springs were more constant, between 56 and 60 °F (13 and 15°C).

The riparian zone of Bluewater Spring Creek is in good condition above the hatchery but deteriorates in the lower 9 miles. Willow and water birch are the dominant woody species in the upper reaches in addition to grasses and forbs. Clumps of willow and water birch are present on the lower reaches but much of the riparian zone has been disturbed by agricultural practices.

Habitat Trend and Limiting Factors

Cattle grazing and intensive agricultural practices along the stream banks in the lower reaches have caused bank sloughing, woody riparian vegetation loss, and channel widening. Irrigation return water contributes considerable turbidity. Although grazing

by cattle has occurred in the upper drainage, damage to the stream channel has not been extensive.

Fisheries

Game species in Bluewater Creek include brown trout and mountain whitefish. Historically, the stream was dominated by Yellowstone cutthroat trout. Brook trout were also common in the late 1930s but have not been surveyed in recent years (Marcuson 1979). Nongame species include longnose dace, flathead chub, mountain and white sucker, carp, and shorthead redhorse.

Marcuson (1979) summarized 6 years of population estimates collected from 1969 to 1975 for a 1 mile section in the upper reach. A total of 3,184 brown trout less than 6 inches and 1,336 brown trout greater than 6 inches were estimated. Mean lengths ranged from 3.6 to 9.3 inches. Maximum length recorded was 22 inches. Marcuson felt the creek's potential for producing larger trout with better growth, indicated by its fertility and available habitat, was not being met. Overpopulation of gamefish was suggested as the limiting factor. A relationship between sediment levels and numbers of trout was also determined. The lower reach of the creek is dominated by nongame fish although brown trout were occasionally collected (Marcuson 1979).

Potential Value and Management Recommendations

Bluewater Spring Creek has the potential of becoming an outstanding spring creek fishery. Based on the quality of the springs and their water coupled with a lack of trout water in southeastern Montana, every effort should be made to improve and secure Bluewater Spring Creek. A rehabilitation plan should be developed. Strategies could include fencing, developing alternative irrigation sources, and fencing. An instream flow reservation should be filed on Bluewater Spring Creek.

SOAP CREEK

Region: 5 Water Code: NA
Legal Description: Origin: T07S, R32E, Section 33BD
Mouth: T07S, R32E, Section 02AC

General Description

Soap Creek flows in a northwesterly direction for approximately 32 miles before entering the Bighorn River at mile 74.6. The entire drainage is on the Crow Indian Reservation. There are 3 tributaries in the drainage, West Fork and Dry Soap Creek, and Goose Coulee. Numerous springs provide the majority of the creek's flow between Limestone Canyon at mile 31.2 and Dry Soap Creek at mile 22.2. Land use activities along the stream include cattle grazing and hay production. One major irrigation diversion is located 2 miles above the mouth.

Water quality and quantity data and physical data have been collected on Soap Creek over the years. Flow measurements taken in 1965 below the springs ranged from 13-21.6 cfs. Water temperatures in the spring area were measured from April to September, 1983 (Brian Sanborn, pers. comm.). Temperatures ranged from 34 to 68°F (1 to 20°C). Mean July temperatures were 58°F (14°C). The substrate in the spring area is composed of a clean gravel/boulder mixture with a low percentage of fines. The bottom is covered by dense beds of watercress, water buttercup, and calcite deposits. The riparian zone is in good condition with species composition including willow, grasses and forbs.

Resident gamefish species surveyed in the spring area include rainbow, brown, and brook trout (Brian Sanborn, pers. comm.). Nongame species surveyed were white and longnose sucker, longnose dace and lake chubs.

The spring area of Soap Creek is used by Bighorn River rainbow trout for spawning. To what extent has not been quantified (Jim Darling, pers. comm.). It is believed that many of the spawning rainbow travel into to the irrigation diversion located 2 miles above the mouth. The irrigators have entered into a cooperative agreement with DFWP to improve spawner passage and to screen the diversion to prevent spawner use and encourage fry movement to the river.

CONCLUSIONS AND RECOMMENDATIONS

In 1985, a spring creek inventory was conducted in Montana. The inventory surveyed nearly 70 spring creeks in the state. Mean annual flows were generally above 5 cfs unless local importance warranted the inclusion of smaller streams. In 1989, the inventory was updated using interviews with MDFWP fisheries biologists and managers and other persons involved in the original inventory.

Based on the site inspections and from existing data, the majority of Montana's spring creeks were in a deteriorated state. Agricultural practices including livestock and cattle production are the major land uses in the valleys where spring creeks originate and flow. Spring creek flows have been diverted or augmentd by river water for irrigation purposes, riparian habitat has been removed, and livestock use has caused losses in bank and instream cover, channel widening, and sediment deposition. Management recommendations in this report concluded major efforts are necessary on most creeks to rehabilitate and restore them to their original condition.

Since the original inventory, the private sector and public agencies have both demonstrated concern for Montana's spring creek resources. Major rehabilitation projects occurred on four spring creeks between 1986 and 1989. The rehabilitation of DePuy's Spring Creek resulted in part from the desire to expand fishing opportunities and increase revenues. The benefits from the rehabilitation, however, were not limited to the resident fishery in the creek. The rehabilitation provided improved access to the stream by spawning trout from the Yellowstone River. East Spring Creek in the Flathead River drainage resulted from interest by the Soil Conservation Service and included private and public sector cooperation. Rehabilitation of Willow Springs in the Jefferson River drainage and Mill Creek in the Flathead River drainage were initiated by MDFWP personnel but cooperation from landowners was critical for their completion and success. Several other smaller projects and continued rehabilitation work on Mitchell Slough in the Bitterroot River drainage and Stutches Creek in the Yellowstone continue to contribute to the restoration of these spring creeks.

The public benefit from rehabilitation projects on spring creeks to date have been realized by off-site values, such as increased spawning habitat for main stem trout populations. Publicly owned spring creeks remain limited to Poindexter Slough in the Beaverhead River drainage. Public access is available to portions of Big Spring Creek near Lewistown. On all other spring creeks, anglers must gain landowner permission or pay of a fee.

Spring creeks should be prioritized for rehabilitation, conservation easements, and potential acquistion. A fisheries and habitat survey should be conducted by MDFWP on all spring creeks with a flow greater than 15 cfs. Surveys would be dependent on landowner permission and interest. Following these surveys,

creeks should be prioritized. Criteria could include potential resident fisheries habitat, main stem spawning habitat availability, and water quality and quantity needs in the drainage. The number of landowners and current land use in the drainage would also be factors in determining future plans. Action could be taken by private landowners or conservation organizations, agencies, and others in cooperation with landowners. Acquistion should be considered for the highest priority sites.

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APPENDIX A

WATER QUALITY DATA

ANALYSIS OF WATER SAMPLES FROM THE ENNIS NATIONAL FISH HATCHERY, 24 MAY 1982

Element	Main Hatchery Intake (E-1)	West Heat Pump Outflow (E-2)	East Heat Pump Outflow (E-3)	Main Hatchery Outflow (E-4)	Concentration[a/] Units	Detection Limits
B	<10	<10	<10	<10	ppb	10
Cd	< 0.5	< 0.5	< 0.5	< 0.5	ppm	0.5
Be	< 2	< 2	< 2	< 2	ppb	2
Mg	14.0	7.3	10.8	19.3	ppm	0.1
P	< 1	< 1	< 1	< 1	ppm	1
Si	3.6	3.4	3.6	3.3	ppm	0.05
Mo	< 0.05	< 0.05	< 0.05	< 0.05	ppm	0.05
Mn	7	9	10	25	ppb	2
Ni	< 0.05	< 0.05	< 0.05	< 0.05	ppm	0.05
Na	3.1	3.1	3.1	3.2	ppm	0.05
Cu	< 2	< 2	3	< 2	ppb	2
Al	< 0.02	< 0.02	< 0.02	< 0.02	ppm	0.02
Ca	47.9	45.4	46.0	45.0	ppm	0.01
Ba	53	51	55	55	ppb	1
K	1.51	1.42	1.46	1.49	ppm	0.05
Cr	< 0.1	< 0.1	< 0.1	< 0.1	ppm	0.1
Sr	< 0.05	< 0.05	< 0.05	< 0.05	ppm	0.05
Pb	< 0.3	< 0.3	< 0.3	< 0.3	ppm	0.3

[a/] ppm = µg/ml, ppb = µg/l

Table II-8 (continued)

PARAMETER	Stanley Cr. NAD	SC1	SC3	LC1	LC2	LC4	KR1	SAO	Lake Cr. near Troy	Stanley Cr. near Troy	Ross Cr. near Troy	Bull R. No. 12	S. End of Bull Lake	Spar Lake near campground
Oil and Grease (mg/l)	-	-	-	-	-	-	-	-	-	-	-	5.9	6.0	7.7
BOD (mg/l as O_2)	-	-	-	-	-	-	-	-	-	-	-	0.9	1.3	0.8
COD (mg/l as O_2)	-	-	-	-	-	-	-	-	-	-	-	2.8	6.65	7.35
ABS (mg/l as O_2)	-	-	-	-	-	-	-	-	-	-	-	0.03	0.03	0.01
Aluminum, Diss. (mg/l as Al)	<.10	-	-	-	-	-	-	-	-	-	-	.06	<.001	<.001
Aluminum, TR (mg/l as Al)	<.10	-	-	-	-	-	-	-	-	-	-	-	-	-
Antimony, Diss. (mg/l as Sb)	-	-	-	-	-	-	-	-	-	-	-	.14	.10	.082
Arsenic, Diss. (mg/l as As)	<.001	-	-	-	-	-	-	-	.000	.000	.000	.002	<.001	<.001
Arsenic, TR (mg/l as As)	.001	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Total (mg/l as As)	-	-	-	-	-	-	-	-	.000	.000	.000	-	-	-
Barium, Diss. (mg/l as Ba)	-	-	-	-	-	-	-	-	-	-	-	1.52	1.04	.79
Beryllium, Diss. (mg/l as Be)	-	-	-	-	-	-	-	-	-	-	-	<.001	<.001	<.001
Boron, Diss. (mg/l as B)	-	-	-	-	-	-	-	-	.000	.000	.000	-	-	-
Cadmium, Diss. (mg/l as Cd)	<.005	-	-	-	-	-	-	-	.000	.000	.000	.009	<.001	<.001
Cadmium, TR (mg/l as Cd)	<.005	-	-	-	-	-	-	<.005	-	-	-	-	-	-
Cadmium, Total (mg/l as Cd)	-	-	-	-	-	-	-	-	<.010	<.010	<.010	-	-	-
Chromium, Diss. (mg/l as Cr)	-	-	-	-	-	-	-	-	.000	.000	.000	<.001	<.001	<.001
Chromium, Total (mg/l as Cr)	-	-	-	-	-	-	-	-	.000	.000	.000	-	-	-
Cobalt, Diss. (mg/l as Co)	-	-	-	-	-	-	-	-	-	-	-	<.001	<.001	<.001
Copper, Diss. (mg/l as Cu)	.02	.01	<.01	<.01	<.01	<.01	<.01	-	.000	.000	.000	.003	.003	.004
Copper, TR (mg/l as Cu)	.02	-	<.01	-	-	-	-	.05	-	-	-	-	-	-
Copper, Total (mg/l as Cu)	-	-	-	-	-	-	-	-	<.010	<.010	<.010	-	-	-
Iron, Diss. (mg/l as Fe)	<.01	-	<.05	-	-	-	-	-	.020	.010	.010	.27	.091	.03
Iron, TR (mg/l as Fe)	<.01	-	<.05	-	-	-	-	<.05	-	-	-	-	-	-
Iron, Total (mg/l as Fe)	-	-	-	-	-	-	-	-	.810	.010	.060	-	-	-
Lead, Diss. (mg/l as Pb)	<.05	-	-	-	-	-	-	-	.000	.000	.000	.005	.002	.009
Lead, TR (mg/l as Pb)	<.05	-	-	-	-	-	-	<.05	-	-	-	-	-	-
Lead, Total (mg/l as Pb)	-	-	-	-	-	-	-	-	<.100	<.100	<.100	-	-	-
Manganese, Diss. (mg/l as Mn)	-	-	-	-	-	-	-	-	.000	.000	.010	.008	.015	.005
Manganese, TR (mg/l as Mn)	-	-	-	-	-	-	-	.03	-	-	-	-	-	-
Manganese, Total (mg/l as Mn)	-	-	-	-	-	-	-	-	.020	.000	.010	-	-	-
Mercury, Diss. (mg/l as Hg)	<.0002	-	-	-	-	-	-	-	.0000	.0000	.0000	<.001	<.001	.002
Mercury, TR (mg/l as Hg)	<.0002	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury, Total (mg/l as Hg)	-	-	-	-	-	-	-	-	.0000	.0000	.0002	-	-	-
Molybdenum, Diss. (mg/l as Mo)	-	-	-	-	-	-	-	-	-	-	-	<.01	<.01	<.01
Selenium, Diss. (mg/l as Se)	-	-	-	-	-	-	-	-	.000	.000	.000	<.002	<.002	<.002
Selenium, Total (mg/l as Se)	-	-	-	-	-	-	-	-	.000	.000	.001	-	-	-
Silver, Diss. (mg/l as Ag)	-	-	-	-	-	-	-	-	-	-	-	<.001	<.001	<.001
Silver, TR (mg/l as Ag)	-	-	-	-	-	-	-	<.01	-	-	-	-	-	-
Tellurium, Diss. (mg/l as Te)	-	-	-	-	-	-	-	-	-	-	-	.009	.012	.02

Table II-8 (continued)

PARAMETER	Stanley Cr. NAD	SC1	SC3	LC1	LC2	LC4	KR1	SA0	Lake Cr. near Troy	Stanley Cr. near Troy	Ross Cr. near Troy	Bull R. No. 12	S. End of Bull Lake	Spar Lake near camp-ground
Tin, Diss. (mg/l as Sn)	-	-	-	-	-	-	-	-	-	-	-	.10	<.01	<.01
Titanium, Diss. (mg/l as Ti)	-	-	-	-	-	-	-	-	-	-	-	<.01	<.01	<.01
Zinc, Diss. (mg/l as Zn)	<.01	<.01	<.01	<.01	<.01	<.01	<.01	-	.000	.000	.000	.020	.006	.004
Zinc, TR (mg/l as Zn)	<.01	-	<.01	-	-	-	-	<.01	-	-	-	-	-	-
Zinc, Total (mg/l as Zn)	-	-	-	-	-	-	-	-	.040	.000	.000	-	-	-

TOSTON SPRINGS WATER QUALITY DATA: COLLECTED BY THE USGS IN 1922 AND 1949

Analyses of Spring Water
(Parts Per Million)

Constituent	Big Spring 1922	Big Spring 1949
Silica (SiO_2)	20	23
Calcium (Ca)	46	44
Magnesium (Mg)	17	18
Sodium and Potassium (Na + K)	17	19
Bicarbonate (HCO_3)	183	192
Sulfate (SO_4)	57	52
Chloride (Cl)	8	7
Nitrate (NO_3)	0.49	0.8
Hardness (as $CaCO_3$)	185	184
Dissolved Solids	259	266

The U. S. Geological Survey properly concluded that the properties of the spring water had undergone little change between 1922 and 1949.

BLUEWATER CREEK, YELLOWSTONE RIVER DRAINAGE

Range and mean chemical values at two stations on Bluewater Creek

	Stations 1	2
Alkalinity (ppm $CaCO_3$)		
range	94. - 220	101 - 252
mean	210	212.
Dissolved oxygen (ppm)		
range	7.8 - 10.8	8.0 - 10.4
mean	8.7	8.6
pH		
range	7.6 - 8.6	6.6 - 8.7
Total hardness (ppm $CaCO_3$)		
range	280 - 750	480 - 1,050
mean	451	850
Conductivity (Umhos)		
range	721 - 938	812 - 2,650
mean	825	1,122
Silica (ppm)		
range	8.2 - 12.4	8.0 - 12.8
mean	11.2	12.4
Phosphate (P)	.01	.02
Sodium (Na^+)	5.52	12.87
Potassium (K^+)	1.96	2.42
Sulfate ($SO_4=$)	25.8	70.8
Nitrogen (NO_{3-N})	.312	.409
Chloride (ppm)	2.20	2.45
Fluoride (ppm)	1.12	1.19

GIANT SPRINGS

STATE	MONTANA	COUNTY	CASCADE
LATITUDE-LONGITUDE	47D32'04"N 111D13'45"W	SITE LOCATION	21N 4E 33 BDAD 1
UTM COORDINATES	Z12 N5264345 E482820		MBMG SITE
TOPOGRAPHIC MAP	NORTHEAST GREAT FALLS 7 1	STATION ID	473204111134501
GEOLOGIC SOURCE	330MDSN* *	SAMPLE SOURCE	SPRING
DRAINAGE BASIN	BB	LAND SURFACE ALTITUDE	324.0 FT < 10
AGENCY + SAMPLER	USGS*KRW	SUSTAINED YIELD	298. CFS
BOTTLE NUMBER	1	YIELD MEAS METHOD	CURRENT METER
DATE SAMPLED	20-AUG-79	TOTAL DEPTH OF WELL	
TIME SAMPLED	12:00 HOURS	SWL ABOVE(-) OR BELOW GS	
LAB + ANALYST	MBMG*FNA	CASING DIAMETER	
DATE ANALYZED	04-APR-80	CASING TYPE	
SAMPLE HANDLING	3120	COMPLETION TYPE	*
METHOD SAMPLED	GRAB	PERFORATION INTERVAL	
WATER USE	OTHER		

SAMPLING SITE GIANT SPRINGS*1 MI W RAINBOW DAM
GEOLOGIC SOURCE MADISON GROUP OR LIMESTONE

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	90.7	4.53	BICARBONATE (HCO3)	221.	3.62
MAGNESIUM (MG)	30.3	2.49	CARBONATE (CO3)	0.	
SODIUM (NA)	9.2	0.40	CHLORIDE (CL)	4.9	0.14
POTASSIUM (K)	2.3	0.06	SULFATE (SO4)	180.	3.75
IRON (FE)	.10	0.01	NITRATE (AS N)	.53	0.04
MANGANESE (MN)	.01	0.00	FLUORIDE (F)	.5	0.03
SILICA (SIO2)	11.2		PHOSPHATE TOT (AS P)		
TOTAL CATIONS		7.48	TOTAL ANIONS		7.57

STANDARD DEVIATION OF ANION-CATION BALANCE (SIGMA) 0.41

54°F

LABORATORY PH	7.73	TOTAL HARDNESS AS CACO3	351.19
FIELD WATER TEMPERATURE	12.5	TOTAL ALKALINITY AS CACO3	181.26
CALCULATED DISSOLVED SOLIDS	438.61	SODIUM ADSORPTION RATIO	0.21
SUM OF DISS. CONSTITUENT	550.74	RYZNAR STABILITY INDEX	6.84
LAB SPEC.COND.(MICROMHOS/CM)	627.8	LANGLIER SATURATION INDEX	0.45

PARAMETER	VALUE	PARAMETER	VALUE
PH,FIELD(SU)	7.4	CNDUCTVY,FIELD MICROMHOS	630.
LITHIUM,DISS(MG/L AS LI)	.027	ARSENIC,DISS(UG/L AS AS)	1.3
MERCURY,DISS(UG/L AS HG)	.3	CHROMIUM, DISS (MG/L-CR)	<.01
COBALT,DISS (MG/L AS CO)	.03	LITHIUM,DISS(MG/L AS LI)	.027
CADMIUM,DISS(MG/L AS CD)	<.01	COPPER,DISS (MG/L AS CU)	<.01
ZINC,DISS (MG/L AS ZN)	<.01	LEAD,DISS (MG/L AS PB)	<.05

REMARKS: CASCADE COUNTY * STATE FISH HATCHERY * SAMPLED FROM STILLING WELL IN PUMP HOUSE *

EXPLANATION: MG/L = MILLIGRAMS PER LITER, UG/L = MICROGRAMS PER LITER, MEQ/L = MILLIEQUIVELENTS PER LITER. FT = FEET, MT = METERS. (M) = MEASURED, (E) = ESTIMATED, (R) = REPORTED. TR = TOTAL RECOVERABLE. TOT = TOTAL.

	QW	WA	62	WI	OW	PW	AT	OTHER
OTHER AVAILABLE DATA	Y			Y				
OTHER FILE NUMBERS:	72M0338			79I00191				

PROJECT:
LAST EDIT DATE: 27-MAY-80
PROCESSING PROGRAM: F1730P V1 (8/20/79)

COST:
BY: TP *CLB
PRINTED: 27-MAY-80

PERCENT MEQ/L (FOR PIPER PLOT)

CA	MG	NA	K	CL	SO4	HCO3
60	33	5	0	1	49	47

NOTE: IN CORRESPONDENCE, PLEASE REFER TO LAB NUMBER: 79M3219

1,000,000 - 2"-6" Fish per year. 12,000 - 7-9

Rb 850,000

APPENDIX B

FISHES OF MONTANA

STANLEY CREEK, KOOTENAI RIVER DRAINAGE

Table II-8 TYPICAL WATER QUALITY DATA FROM SELECTED STREAMS AND LAKES IN THE LAKE CREEK DRAINAGE, LINCOLN COUNTY, MONTANA

	STATION													
	Stanley Ck								Lake Cr. near	Stanley Cr. near	Ross Cr. near		S. End	Spar Lake
PARAMETER	NAO	SC1	SC3	LC1	LC2	LC4	KR1	SAD	Troy	Troy	Troy	Bull R. No. 12	of Bull Lake	near campground
Sampling Agency	WQB	WQB	WQB	WQB	WQB	WQB	WQB	WQB	USGS	USGS	USGS	ASARCO	ASARCO	ASARCO
Date Sampled	6/26/77	6/26/77	3/21/77	6/26/77	6/25/77	6/25/77	6/25/77	9/30/76	4/28/77	4/28/77	4/28/77	10/16/75	16/16/75	10/16/75
Temperature (°C)	5.0	9.0	5.5	18.0	15.0	15.0	12.0	6.5	6.5	5.5	6.5	8.5	13.0	11.0
Flow (cfs)	.15	2.1	-	93	87	147	3450	-	660	34	300	-	-	-
Specific Conductance (umhos/cm)	116	57	51	62	67	84	261	187	55	56	45	66	43	28
Total Dissolved Solids (mg/l)	100	-	60.	-	-	-	-	147	32	36	27	94	78	36
pH (units)	8.1	8.2	7.7	8.2	8.0	8.2	8.5	7.3	8.0	7.6	7.8	7.3	7.6	7.4
Total Suspended Solids (mg/l)	10.8	11.7	-	<11.1	<9.4	<13.0	<9.5	-	-	-	-	-	-	-
Turbidity (JTU)	0.3	0.3	-	0.6	0.4	0.7	0.8	-	15.0	0	1.0	.38NTU	.34 NTU	.33 NTU
Alkalinity (mg/l as $CaCO_3$)	60	-	27	-	-	-	109	-	23	28	18	-	-	-
Hardness, Total (mg/l)	58	-	36	-	-	-	95	-	25	31	21	-	-	-
Non Carbonate Hardness (mg/l)	-	-	-	-	-	-	-	-	2	3	3	-	-	-
Calcium (mg/l as Ca)	19.6	-	10.5	-	-	-	-	27.3	7.1	8.9	6.2	12.2	7.9	4.9
Magnesium (mg/l as Mg)	2.2	-	2.5	-	-	-	-	6.5	1.7	2.2	1.4	3.45	1.89	1.08
Sodium (mg/l as Na)	0.8	-	0.4	-	-	-	-	1.1	.7	.5	.2	.95	.58	.56
Potassium (mg/l as K)	0.38	-	0.0	-	-	-	-	0.43	.4	.2	.1	1.0	.66	.54
Bicarbonate (mg/l as HCO_3)	73	-	33	-	-	-	129	91	28	34	22	22.9	14.8	9.0
Carbonate (mg/l as CO_3)	0	-	0	-	-	-	2	0	0	0	0	0	0	0
Chloride (mg/l as Cl)	0.5	-	0.1	-	-	-	-	0	.2	.1	.3	1.25	.38	.27
Sulfate (mg/l as SO_4)	3.2	-	14.0	-	-	-	-	20.0	2.9	1.8	3.7	<1.0	<1.0	<1.0
Fluoride (mg/l as F)	<0.5	-	-	-	-	-	-	.12	.0	.0	.1	.08	.03	.056
Silicate (mg/l as SiO_2)	-	-	-	-	-	-	-	-	5.2	5.8	4.3	-	-	-
Cyanide (mg/l as CN)	-	-	-	-	-	-	-	-	.00	.00	.00	.002	<.001	<.001
Total Nitrogen (mg/l as N)	<0.10	.47	-	.49	.39	.49	.37	-	.10	.09	.38	-	-	-
Total Organic Nitrogen (mg/l as N)	-	-	-	-	-	-	-	-	.00	.00	.00	-	-	-
Total NH_3 Nitrogen (mg/l as N)	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	.00	.00	.00	-	-	-
Total Kjeldahl Nitrogen (mg/l as N)	-	-	-	-	-	-	-	-	.00	.00	.00	-	-	-
Total NO_2+NO_3 (mg/l as N)	.21	.14	-	.04	.04	.03	<.01	.45	.10	.09	.38	.01	.004	.004
Total Phosphorus (mg/l as P)	.004	.009	-	.004	.004	.004	.008	-	.00	.00	.01	-	-	-
Phosphate (mg/l as P)	.002	-	-	.001	<.001	<.001	<.001	-	-	-	-	.025	.055	.02
Sodium Adsorption Ratio	0.0	-	0.0	-	-	-	-	0.0	0.1	0.0	0.0	-	-	-
Carbon Oioxide (mg/l as CO_2)	-	-	-	-	-	-	-	-	0.4	1.4	0.6	-	-	-
Oissolved Oxygen (mg/l as O_2)	-	-	-	-	-	-	-	-	11.0	11.5	11.8	12.9	11.3	10.0
Total Coliform/100 ml	-	-	-	-	-	-	-	-	-	-	-	4	12	2
Fecal Coliform/100 ml	-	-	-	-	-	-	-	-	-	-	-	0	0	0
Phenol (mg/l)	-	-	-	-	-	-	-	-	-	-	-	<.008	<.008	<.008

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	MADISON
LAT.-LONG.	+453159N 1114744W	SAMPLE LOCATION	7S 2W 13C
STATION CODE		ANALYSIS NUMBER	76W0326
DATE SAMPLED	02-25-76	DRAINAGE BASIN	
TIME SAMPLED	1500	WATER FLOW RATE	.
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	
SAMPLE SOURCE	BLAINE SPRING CREEK	ALTITUDE OF LAND SURFACE	
WATER USE		TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	NFH	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: ENNIS NATIONAL FISH HATCHERY

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	47.9	2.392	BICARBONATE(HCO3)	182.	2.989
MAGNESIUM (MG)	23.7	1.946	CARBONATE (CO3)	0.	0.0
SODIUM (NA)	2.5	0.109	CHLORIDE (CL)	0.5	0.014
POTASSIUM (K)			SULFATE (SO4)	66.	1.374
IRON (FE)			FLUORIDE (F)	.36	0.020
MANGANESE (MN)			NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)	.42	0.023
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		4.417	TOTAL ANIONS		4.420

LABORATORY PH	8.12	TOTAL HARDNESS AS CACO3	216
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	150.
DISSOLVED SOLIDS CALCULATED	323.3	LAB TURBIDITY (JTU)	
LAB CONDUCTIVITY-UMHOS-25C	423.	SODIUM ADSORPTION RATIO	0.1

ADDITIONAL PARAMETERS

IRON,TR (MG/L AS FE) .05

REMARKS: PRIVATE WATER SUPPLY WARM SPRINGS

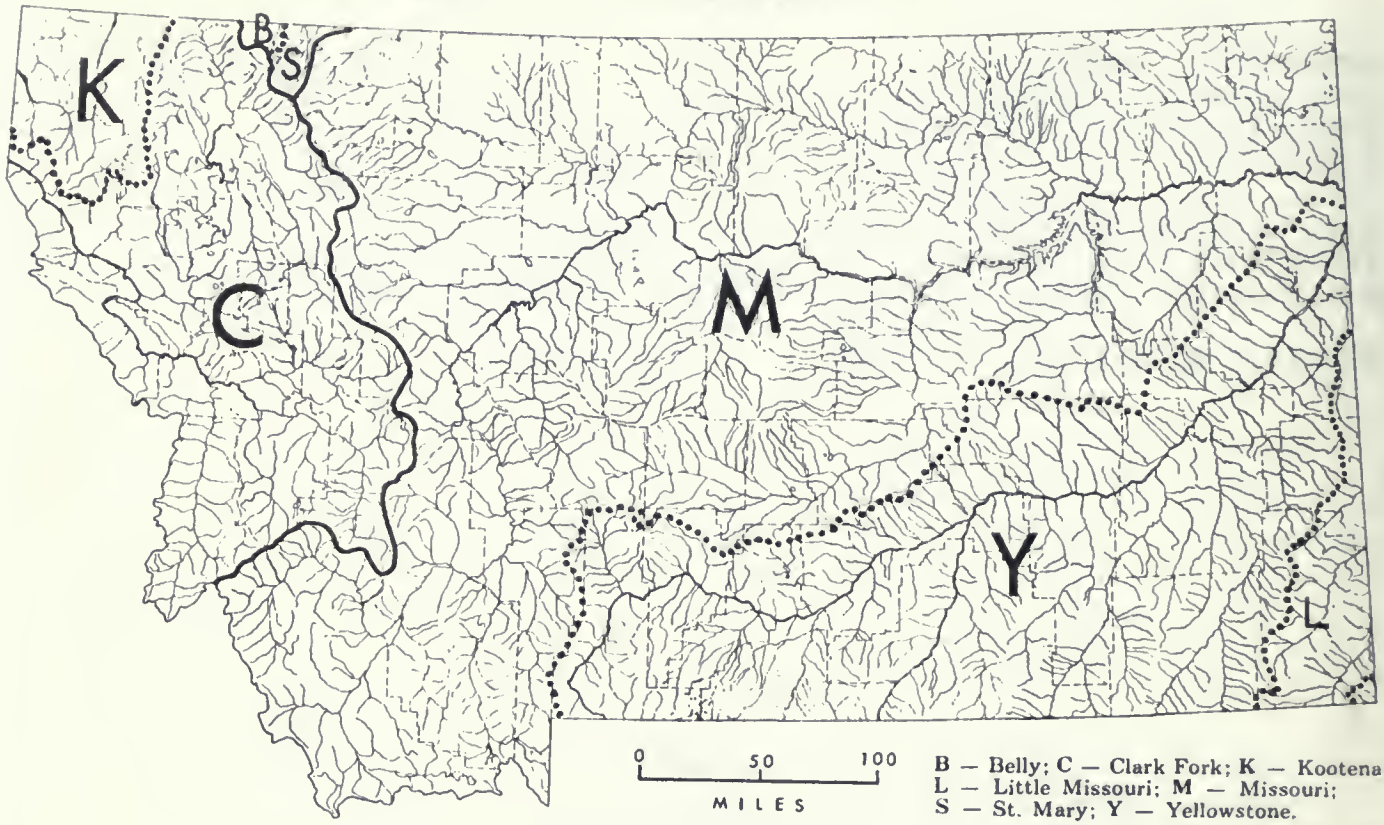
EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO. SAMPLER WHO HANDLING 1000 ANALYST ME LAB WQBH
COMPLETED 03-10-76 COMPUTER RUN 03/17/76 PROGRAM SYS 75 FUND 0650
STND DEV. ION BALANCE 0.02 CA MG NA K CL SO4 HCO3 CO3 NO3
SEGMENT MODES 54.2 43.4 2.5 0.0 0.5 31.4 68.3 0.0 0.0
76W0326

APPENDIX B

FISHES OF MONTANA

MONTANA – STREAM DRAINAGES



B — Belly; C — Clark Fork; K — Kootenai;
L — Little Missouri; M — Missouri;
S — St. Mary; Y — Yellowstone.

LIST OF MONTANA FISHES

FAMILY		SPECIES		DRAINAGE**						
Common name	Scientific name	Common name	Scientific name	M	Y	L	C	K	S	B
Sturgeon	Acipenseridae	White sturgeon	*Acipenser transmontanus* Richardson					x		
		Pallid sturgeon	*Scaphirhynchus albus* (Forbes and Richardson)	x	x					
		Shovelnose sturgeon	*Scaphirhynchus platorynchus* (Rafinesque)	x	x					
Paddlefish	Polyodontidae	Paddlefish	*Polyodon spathula* (Walbaum)	x	x					
Gar	Lepisosteidae	Shortnose gar	*Lepisosteus platostomus* Rafinesque	x						
Mooneye	Hiodontidae	Goldeye	*Hiodon alosoides* (Rafinesque)	x	x	x				
Trout	Salmonidae	*Lake whitefish	*Coregonus clupeaformis* (Mitchill)	x			x		x	x
		Mountain whitefish	*Prosopium williamsoni* (Girard)	x	x		x	x	x	
		Pygmy whitefish	*Prosopium coulteri* (Eigenmann and Eigenmann)				x	x		
		*Coho salmon	*Oncorhynchus kisutch* (Walbaum)	x			x			
		*Kokanee	*Oncorhynchus nerka* (Walbaum)	x	x		x	x	x	
		*Golden trout	*Salmo aguabonita* Jordan	x	x		x			
		Cutthroat trout	*Salmo clarki* Richardson	x	x		x	x	x	x
		*Rainbow trout	*Salmo guirdneri* Richardson	x	x		x	x		
		*Brown trout	*Salmo trutta* Linnaeus	x	x		x			
		*Brook trout	*Salvelinus fontinalis* (Mitchill)	x	x	x	x	x	x	x
		Dolly Varden	*Salvelinus malma* (Walbaum)				x	x	x	
		Lake trout	*Salvelinus namaycush* (Walbaum)	x	x		x	x	x	x
		Arctic grayling	*Thymallus arcticus* (Pallas)	x	x		x		x	x
Pike	Esocidae	*Northern pike	*Esox lucius* Linnaeus	x	x		x		x	
Minnow	Cyprinidae	*Carp	*Cyprinus carpio* Linnaeus	x	x	x				
		*Goldfish	*Carassius auratus* (Linnaeus)	x	x					
		*Golden shiner	*Notemigonus crysoleucas* (Mitchill)	x	x	x				
		Pearl dace	*Semotilus margarita* (Cope)	x	x				x	
		Creek chub	*Semotilus atromaculatus* (Mitchill)		x	x				
		Northern redbelly dace	*Phoxinus eos* (Cope)	x						
		Finescale dace	*Phoxinus neogaeus* Cope	x						

FAMILY		SPECIES		DRAINAGE**						
Common name	Scientific name	Common name	Scientific name	M	Y	L	C	K	S	B
		*Utah chub	*Gila atraria* (Girard)	x						
		Flathead chub	*Hybopsis gracilis* (Richardson)	x	x	x				
		Sturgeon chub	*Hybopsis gelida* (Girard)		x					
		Lake chub	*Couesius plumbeus* (Agassiz)	x	x	x			x	
		Peamouth	*Mylocheilus caurinus* (Richardson)				x	x		
		Emerald shiner	*Notropis atherinoides* Rafinesque	x	x					
		Sand shiner	*Notropis stramineus* (Cope)		x					
		Brassy minnow	*Hybognathus hankinsoni* Hubbs	x	x	x				
		Plains minnow	*Hybognathus placitus* Girard	x	x	x				
		Silvery minnow	*Hybognathus nuchalis* Agassiz	x	x	x				
		Fathead minnow	*Pimephales promelas* Rafinesque	x	x	x	x			
		Northern squawfish	*Ptychocheilus oregonensis* (Richardson)				x	x		
		Longnose dace	*Rhinichthys cataractae* (Valenciennes)	x	x	x	x	x	x	
		Redside shiner	*Richardsonius balteatus* (Richardson)	x			x	x		
Sucker	Catostomidae	River carpsucker	*Carpiodes carpio* (Rafinesque)	x	x	x				
		Blue sucker	*Cycleptus elongatus* (LeSueur)	x	x					
		Smallmouth buffalo	*Ictiobus bubalus* (Rafinesque)	x	x					
		Bigmouth buffalo	*Ictiobus cyprinellus* (Valenciennes)	x						
		Shorthead redhorse	*Moxostoma macrolepidotum* (LeSueur)	x	x	x				
		Longnose sucker	*Catostomus catostomus* (Forster)	x	x		x	x	x	
		White sucker	*Catostomus commersoni* (Lacépède)	x	x	x			x	x
		Largescale sucker	*Catostomus macrocheilus* Girard				x	x		
		Mountain sucker	*Catostomus platyrhynchus* (Cope)	x	x					
Catfish	Ictaluridae	*Black bullhead	*Ictalurus melas* (Rafinesque)	x	x	x	x	x		
		*Yellow bullhead	*Ictalurus natalis* (LeSueur)		x		x			
		Channel catfish	*Ictalurus punctatus* (Rafinesque)	x	x	x				
		Stonecat	*Noturus flavus* Rafinesque	x	x					
Trout-perch	Percopsidae	Trout-perch	*Percopsis omiscomaycus* (Walbaum)						x	
Codfish	Gadidae	Burbot	*Lota lota* (Linnaeus)	x	x			x	x	x
Killifish	Cyprinodontidae	Plains killifish	*Fundulus kansae* Garman		x					
Livebearer	Poeciliidae	*Mosquitofish	*Gambusia affinis* (Baird and Girard)				x			
		*Shortfin molly	*Poecilia mexicana* Steindachner	x						
		*Variable platyfish	*Xiphophorus variatus* (Meek)	x			x			
		*Green swordtail	*Xiphophorus helleri* Heckel	x						
Stickleback	Gasterosteidae	Brook stickleback	*Culaea inconstans* (Kirtland)	x	x	x				
Sunfish	Centrarchidae	*Rock bass	*Ambloplites rupestris* (Rafinesque)		x					
		*Green sunfish	*Lepomis cyanellus* Rafinesque	x	x	x				
		*Pumpkinseed	*Lepomis gibbosus* (Linnaeus)	x	x		x	x		
		*Bluegill	*Lepomis macrochirus* Rafinesque	x	x					
		*Smallmouth bass	*Micropterus dolomieui* (Lacépède)				x			
		*Largemouth bass	*Micropterus salmoides* (Lacépède)	x	x		x	x		
		*White crappie	*Pomoxis annularis* Rafinesque	x	x					
		*Black crappie	*Pomoxis nigromaculatus* (LeSueur)	x	x					
Perch	Parcidae	*Yellow perch	*Perca flavescens* (Mitchill)	x	x		x	x		
		Sauger	*Stizostedion canadense* (Smith)	x	x					
		*Walleye	*Stizostedion vitreum* (Mitchill)	x	x	x				
		Iowa darter	*Etheostoma exile* (Girard)	x	x	x				
Drum	Sciaenidae	Freshwater drum	*Aplodinotus grunniens* Rafinesque	x	x					
Sculpin	Cottidae	Mottled sculpin	*Cottus bairdi* Girard	x	x				x	
		Slimy sculpin	*Cottus cognatus* Richardson				x	x		
		Torrent sculpin	*Cottus rhotheus* (Rosa Smith)					x		
		Shorthead sculpin	*Cottus confusus* Bailey and Bond				x			
		Spoonhead sculpin	*Cottus ricei* (Nelson)						x	

* Not native

** Drainage: M — Missouri; Y — Yellowstone; L — Little Missouri; C — Clark Fork; K — Kootenai; S — St. Mary; B — Belly

APPENDIX C

HOT AND WARM SPRINGS

IN MONTANA

TABLE 1 — SPRINGS, INVENTORY DATA

Spring Name	Location T	R	S	Tr.	Latitude	Longitude	Altitude (Ft.)	Topographic Map	Source of Water	Estimated Reservoir Temp. °C	Observed Temp. °C	Dates	Agency	pH	SC (μmho/cm) @ 25° C	TDS
Alhambra	8N	3W	16	ACAA	46.4486	111.9828	4,360	Clancy 15'	Boulder batholith: See U.S.G.S. Open-File Report 78-438	96	55.6	08-23-74	USGS*	7.23	929	660
												09-01-72	MBMG	8.84†	929	630
Anaconda	4N	11W	13	AAA	46.1044	112.9039	5,490	Anaconda 15'	Tertiary volcanics or Madison	75	21.7	06-23-78	MBMG	7.31	2624	2310
Anderson's	3S	13E	29	ABAB	45.5530	110.1422	5,540	McLeod Basin 7.5'	Madison	30	25.0	07-25-72	MBMG	7.84	414	270
Anderson's Pasture	13S	2W	18	ACD	44.7044	111.8925	6,840	Lower Red Rock Lake 15'	Madison 2 springs	45	26.0	10-03-77	MBMG*	7.4	609	401
Apex	5S	9W	10	AADADD	45.4203	112.6911	5,240	Glen 7.5'	Madison	76	25.0	05-25-78	MBMG	7.78	520	340
Avon	10N	8W	24	BBC	46.6111	112.5536	4,900	Avon 15'	Tertiary volcanics, Terrace	--	25.5	06-16-78	MBMG	6.9	870	650†
Bear Creek	9S	9E	19	CAA	45.0320	110.6670	5,600	Gardiner 15'	Tertiary volcanics: Precambrian	--	24.0	05-23-78	MBMG	9.5	2700	2000†
Bearmouth 1 & 2	11N	14W	12	CD	46.7169	113.3031	3,835	Bearmouth 15'	Madison	--	20.2	06-17-78	MBMG	7.6	642	480†
										35	19.6	03-18-72	USGS	7.69	610	420
Beaverhead Rock	5S	7W	22	ABBD	45.3919	112.4511	4,810	Beaverhead Rock 7.5'	Tertiary sediments over Madison (?)	--	27.0	08-21-66	MBMG	7.2	--	--
Bedford	7N	1E	23	BAAD	46.3542	111.5667	3,880	Townsend 15'	Tertiary sediments	30	23.6	06-23-78	MBMG	7.2	467	350
Blue Joint 1	2S	23W	1	ABB	45.6973	114.3809	5,040	Painted Rocks Lake 15'	Idaho batholith: Precambrian Ravalli	45	29.0	08-11-72	MBMG	8.12†	162	145
Blue Joint 2	2S	22W	6	BAD	45.6964	111.3642	4,940	Painted Rocks Lake 15'	Idaho batholith: Precambrian Ravalli	45	29.0	08-11-72	MBMG	8.22†	180	145
Boulder	5N	4W	10	CBA	46.1981	112.0947	4,850	Boulder 15'	Boulder batholith	136	76.0	08-22-74	USGS*	8.50	523	423
												11-24-64	HEALTH	--	--	388
Bozeman	2S	4E	14	DDBAA	45.6608	111.1869	4,735	Bozeman 15'	Pre-Belt, Tertiary sediments	80	54.6	08-25-74	USGS*	8.58	624	433
										--		1964	HEALTH	--	--	428
Bridger Canyon	1S	6E	34	BCDD	45.7078	110.9750	4,890	Bozeman Pass 15'	Madison	25	20.2	--	USFWS	7.7	448	270
Broadwater	10N	4W	28	ACA	46.5958	112.1097	4,100	Helena 15'	Belt and Boulder batholith	118	62.0	08-24-74	USGS*	8.53	796	596
												09-17-64	HEALTH	--	--	563
Brooks	17N	18E	19	DBDBB	47.2192	109.4729	3,760	Lewistown 15'	Kootenai: Madison			08-19-64	HEALTH	--	--	670
												06-12-78	MBMG	7.33	900	680†
										25	19.9	09-23-75	USGS	7.68†	882	622
Browns	8S	9W	30	DCB	45.1047	112.7508	5,575	Dalys 7.5'	Madison: Tertiary volcanics	30	23.7	06-21-78	MBMG	7.4	645	480†
Camas	21N	24W	3	BBDB	47.6136	114.6672	2,830	Hot Springs 7.5'	Piegan: Diorite sill			11-24-64	MBMG	--	--	270
										100	45.0	07-03-75	USGS*	9.39	367	330
												09-15-75	USGS	9.11	394	274
Carter's Bridge	3S	9E	1	AADA	45.6108	110.5694	4,560	Bridbin 7.5'	Madison	40	28.0	12-22-78	MBMG	7.8†	850	600
Chico	6S	8E	1	CDCD	45.3381	110.6911	5,280	Emigrant 15'	Tertiary sediments with Tertiary granite and Madison	58	45.0	08-25-74	USGS*	7.38	379	255
												11-24-64	HEALTH	--	--	254
Deer Lodge Prison	6N	10W	29	BC	46.3331	112.8864	4,960	Racetrack 7.5'	Precambrian Ravalli, 4 springs	40	26.0	03-27-78	MBMG	9.3	220	170
Durfee Creek	12N	23E	19	BB	46.7933	108.8833	4,500	Roundup 1° x 2°	Madison		21.1	06-13-78	MBMG	7.25	1960	1470†
										30	--	08-15-73	MBMG	8.08†	2540	2630
Elkhorn	4S	12W	29	ACAD	45.4592	113.1069	7,200	Polaris 15'	Boulder batholith	65	48.5	08-20-74	USGS*	8.94	209	179
												07-27-72	MBMG	8.49†	219	180
Ennis	5S	1W	28	DCAD	45.3675	111.7256	4,920	Ennis 15'	Tertiary sediments over pre-Belt			02-06-69	HEALTH (?)	--	--	310
										129	83.2	04-01-76	USGS*	7.7	1510	1030
Gallogly	1S	19W	15	BCCCAC	45.7497	113.9400	5,400	Lost Trail Pass 7.5'	Idaho batholith		49.0	08-05-64	HEALTH	--	--	144
										56	--	08-10-72	MBMG	7.81†	202	149
											41.7	10-07-80	MBMG	9.12†	192	153
Garrison	10N	9W	19	ACB	46.6097	112.7747	4,900	Garrison 15'	Cretaceous — near Madison	35	25.0	08-08-72	MBMG	7.30†	737	530
Granite	11N	23W	7	ABDBA	Combined w/Lolo		4,180	Lolo Hot Springs 7.5'	Wallace: Idaho batholith	80	51.0	06-19-78	MBMG	9.3	280	210†
Green Springs	20N	24W	33	CBA	47.4506	114.6486	2,820	Perma 15'	Alluvium: Precambrian Piegan			1964	HEALTH	--	--	162
										--	26.0	06-17-78	MBMG	9.2	370	280†

TABLE 1 -- SPRINGS, INVENTORY DATA (CONTINUED)

Spring Name	Location T	R	S	Tr.	Latitude	Longitude	Altitude (Ft.)	Topographic Map	Source of Water	Estimated Reservoir Temp. °C	Observed Temp. °C	Dates	Agency	pH	SC (μmho/cm) @ 25° C	TDS
Gregson 2 Clark Fk	3N	10W	2	BDCA	46.0433	112.8106	5,130	Anaconda 15'	Tertiary volcanics: Boulder batholith	118	70.0	08-19-74	USGS*	8.41	761	559
												04-08-65	HEALTH (?)	--	--	560
Greyson 3 Missouri	6N	2E	21	BAAA	46.2678	111.4825	3,820	Duck Creek Pass 15'	Tertiary sediments	25	17.9	06-03-78	MBMG	7.6	610	460†
Hunsaker 3 Missouri	4N	2E	32	DBDB	46.0531	111.5011	4,600	Radersburg 15'	Greyson Shale	40	24.5	06-26-79	MBMG	6.90	590	350
Hunters	1S	12E	9	CCADC	45.7572	110.2572	4,380	Hunter's Hot Springs 7.5'	Livingston: Cretaceous volcanics: Tertiary granite	78	59.0	07-02-75	USGS*	9.13	354	280
												07-25-72	MBMG	8.52†	387	280
Jackson 3 - Big Hole	5S	15W	25	CBBB	45.3677	113.4030	6,470	Jackson (Advance) 7.5'	Alluvium: Tertiary sediments: Missoula Group			08-06-64	MBMG	--	--	662
												07-28-72	MBMG	9.04†	1020	660
										125	58.0	08-16-74	USGS*	6.77	972	660
La Duke 3 Yellowstone	8S	8E	32	CDBA	45.0903	110.7733	5,280	Miner 15'	Madison	73	65.0	07-02-75	USGS*	6.52	2460	2080
												07-26-72	MBMG	7.62†	2400	2030
Landusky 1 & 2 ? Missouri	25N	24E	32	DBAD	47.8764	108.6572	3,710	Hays 7.5'	Madison: Jurassic	35	21.0	08-16-73	MBMG	8.03†	1800 (?)	1480
Landusky Plunge	24N	24E	12	CDDAB	47.8431	108.5986	3,690	Hays SE 7.5'	Madison: Jurassic	30	24.0	08-16-73	MBMG	8.09†	1262	960
Little Warm Springs 1, 2, 3 "	26N	26E	32	ACAAA	47.9692	108.3964	3,360	Bear Mountain 7.5'	Madison: Jurassic		--	08-16-73	MBMG	8.06†	2082	1750
										35	22.5	10-04-73	USGS	7.92†	1823	1540
Lodgepole 1, 2, 3 "	26N	25E	24	CABD	47.9939	108.4444	3,700	Bear Mountain 7.5'	Madison	35	30.0	10-04-73	USGS	8.0†	1430	1100
Lolo 2 - Bitterroot	11N	23W	7	ADCC	46.7253	114.5328	4,155	Lolo Hot Springs 7.5'	Wallace: Idaho batholith	83	44.0	08-17-74	USGS*	9.27	225	200
												08-09-72	MBMG	7.87†	234	200
												06-19-78	MBMG	9.6	307	230†
Lovells 3 - Beaverhead	8S	9W	28	BDBA	45.1114	112.7150	5,490	Gallagher Mountain 7.5'	Tertiary sediments: Tertiary volcanics: Madison	30	19.4	06-21-78	MBMG	7.9	620	420†
McMenomey Ranch 3 Beaverhead	9S	10W	29	AAA	45.0272	112.8444	5449	Dalys 7.5'	Madison-Beaverhead contact	30	19.0	03-24-78	PRVT.	7.4†	722	480
Medicine 2 - Bitterroot	1N	20W	12	CCA	45.8456	114.0361	4,440	Medicine Hot Springs 7.5'	Idaho batholith			08-05-64	HEALTH	--	--	170
												08-09-72	MBMG	8.08†	377	260
										82	45.0	08-16-74	USGS*	8.59	343	260
New Biltmore 3 Beaverhead	6S	7W	28	BDA	47.4620	112.4744	4,783	Beaverhead Rock 7.5'	Madison	--		08-06-64	HEALTH	--	--	2004
												07-10-72	MBMG	7.34†	2140	1780
										71	53.0	08-17-74	USGS*	6.76	2160	1860
Nimrod 2 - Clark Fork	11N	15W	14	CDAA	46.7056	113.4569	3,800	Bearmouth 15'	Cambrian: Madison			08-03-64	HEALTH	--	--	722
										30	20.5	03-18-72	USGS	7.63	856	630
												06-17-78	MBMG	7.8	860	645†
Norris 3 Madison	3S	1W	14	DAB	45.5750	111.6831	4,805	Norris 15'	Pre-Belt: Tobacco Root stock	107	52.5	08-21-74	USGS*	7.58	903	640
												11- ? -64	HEALTH	--	--	620
												05-04-70	HEALTH	--	--	700
Pipestone 1 & 2 3 Jefferson	2N	5W	28	BDDD	45.8964	112.2319	4,530	Dry Mountain 7.5'	Boulder batholith	88	57.0	08-18-74	USGS*	8.72	455	340
												08-06-64	HEALTH	--	--	328
Plunkets 3 - Missouri	4N	1E	27	AA	46.0744	111.5844	4,180	Radersburg 15'	Madison			06-02-78	MBMG	8.1	510	380†
										20	16.5	07-10-79	MBMG	7.9	400	260
Potosi 1 3 Jeff	3S	2W	7	CABA	45.5894	111.8986	6,100	Harrison 15'	Tobacco Root stock	60	49.5	08-21-74	USGS*	8.6	470	330
Potosi 2 & 3 3 Jeff	3S	2W	6	CACC	45.6017	111.9003	6,080	Harrison 15'	Tobacco Root stock	60	37.0	06-25-79	MBMG	8.36†	470	360
Pullers 3 - Ruby	8S	5W	1	AACC	45.1714	112.1525	5,485	Metzel Ranch 7.5'	Tertiary sediments: pre-Belt	90	44.4	05-14-76	USGS*	7.7	1680	1160
Quinn's Hot Springs 1 Clark Fk	18N	25W	9	CDADA	47.3297	114.7881	2,560	Plains 15'	Precambrian Piegan			04-08-65	HEALTH	--	--	192
										99	43.4	08-09-72	MBMG	7.91†	205	190
												06-18-78	MBMG	8.9	170	130†
Renova 3 Jefferson	1N	4W	32	DBC	45.7914	112.1265	4,400	Vendome 7.5'	Cambrian, Meagher Limestone	90	50.0	08-13-76	USGS*	7.5	1100	655
Silver Star 3 - Jefferson	2S	6W	1	CCBA	45.6881	112.2942	4,700	Twin Bridges 7.5'	Boulder batholith: pre-Belt contact zone	131	71.5	08-18-74	USGS*	8.17	808	610
												07-10-72	MBMG	8.40†	847	640
Sleeping Child 2 - Bitterroot	4N	19W	7	DCDDBB	46.1053	114.0042	4,750	Deer Mountain 7.5'	Idaho batholith: 2 sources			08-04-64	HEALTH	--	--	400
												08-10-72	MBMG	7.98†	568	390
										125	52.0	08-15-74	USGS*	8.20	538	390
Sloan Cow Camp 3 Madison	12S	1E	19	CDA	44.7692	111.6500	6,560	Cliff Lake 15'	Alluvium: Pleistocene volcanics (?)	85	29.5	09-29-77	MBMG*	10.05	410	260
Staudenmeyer Ranch 3 Red Rock	13S	2W	17	CBA	44.7019	111.8775	6,750	Lower Red Rock Lake 15'	Pleistocene rhyolite, S springs: Chemistry suggests Madison source	45	28.0	10-03-77	MBMG*	7.5	646	390

Spring Name	Location T	R	S	Tr.	Latitude	Longitude	Altitude (Ft.)	Topographic Map	Source of Water	Estimated Reservoir Temp. °C	Observed Temp. °C	Dates	Agency	pH	SC (μ mho/cm) @ 25° C	TDS
Jun River	22N	10W	26	CAB	47.6325	112.8542	4,800	Arsenic Peak 7.5'	Madison, 5 springs	35	30.4	06-15-78	MBMG	7.2	1190	890†
Targhee Sulphur	13S	4E	27	AACA	44.6769	111.2183	6,673	West Yellowstone 15'	Glacial till: volcanics	18	18.0	08-23-79	MBMG	6.69	560	370
Toston	4N	3E	6	DADC	46.1256	111.3908	3,960	Toston 15'	Madison			11-24-64	HEALTH	--	--	238
												06-02-78	MBMG	7.5	440	330†
										20	15.2	06-29-79	MBMG	7.5	440	265
rudau	7S	4W	7	DCAD	45.2350	112.1347	5,675	Metzel Ranch 7.5'	Pre-Belt and Paleozoic	45	22.7	05-25-78	MBMG	8.4	850	540
Vigilante	9S	3W	22	BDDD	45.0175	111.9508	6,200	Varney 15'	Madison	30	23.5	05-25-78	MBMG	7.5	620	400
Warm Springs State Hospital	6N	10W	24	A	46.1786	112.7942	4,820	Anaconda 15'	Boulder batholith (?)	79	77.0	08-19-74	USGS*	6.46	1510	1251
									Madison (?)			04-08-65	HEALTH	--	--	1300
Warner	5N	1E	22	DBBC	46.1708	111.5856	4,100	Radersburg 15'	Alluvium: Tertiary			06-02-78	MBMG	8.2	200	123
									dediments: Precambrian	23	18.0	06-16-79	MBMG	8.1	200	125
West Fork Swimming Hole	12S	1E	18	DB	44.7865	111.6450	6,700	Cliff Lake 15'	Alluvium:	30	26.0	09-29-77	MBMG*	8.30	322	180
									Pleistocene volcanics (?)							
White Sulphur Springs	9N	7E	18	BB	46.5473	110.9039	5,025	White Sulphur Springs 7.5'	Tertiary sediments:			09-01-61	HEALTH	--	--	1450
									Precambrian	125	46.0	08-17-74	USGS*	6.8	2220	1520
Wolf Creek	10S	1E	9	BBBA	44.9843	111.6151	6,100	Cliff Lake 15'	Tertiary sediments:			09-30-77	MBMG	11.03	494	320
									Precambrian	77	68.0	05-13-76	USGS*	8.6	659	360

*Symbol after analysis indicates a preferred analysis, conducted for geothermal evaluation, with a field (rather than laboratory) pH measurement.
†Laboratory pH value, or TDS calculated from specific conductance data using the relationship TDS = 0.75 x SC.

TABLE 2 — SPRINGS, WATER ANALYSIS

Spring Name	Agency	Dates	Ca	Mg	Na	K	SiO_2	HCO_3	CO_3	Cl	SO_4	F	Na + K	Fe	Mn	NO_3	P	CO_2	As	B	H_2S	Li	Field pH	T.D.S.	
Alhambra	USGS	04-08-76	27.	5.2	310.	17.	61.	712.	8	20.	150.	9.0	--	0.12	0.02	0.0	0.02	227.	0.036	0.41	--	0.71	7.2	660	
Anaconda	MBMG	06-23-78	470.	67.	147.	10.6	22.7	439.	0	7.	1360.	2.5	--	1.21	0.48	< 0.10	--	--	--	--	--	0.25	7.0	2,310	
Anderson's	MBMG	07-25-72	47.	23.	1.6	1.3	12.2	88.	0	0.5	139.	0.4	--	N.D.	N.D.	0.3	--	--	--	--	--	< .01	7.4	270	
Anderson's Pasture	MBMG	10-03-77	66.5	24.	27.7	7.3	21.4	246.	0	9.7	114.	1.7	--	< .01	< .01	0.16	--	--	0.0136	0.20	<.10	0.05	7.4	400	
Apex	MBMG	05-25-78	62.	16.2	23.4	3.2	19.8	140.	0	11.55	135.	0.6	--	< .01	< .01	0.92	--	--	--	--	--	--	7.6	340	
Avon	MBMG	06-16-78																					6.9	650†	
Bear Creek	MBMG	05-23-78																					9.5	2,000†	
Bearmouth 1 & 2	USGS	03-18-72	89.	28.	7.6	1.8	16.	220.	0	1.5	163.	0.5	--	0.03	0.01	0.2	--	--	--	--	--	--	7.5	420	
Beaverhead Rock	MBMG	08-21-66																					7.2	--	
Bedford	HEALTH	12-09-64	57.	22.	--	--	--	155.	0	9.	103.	0.7	8.	--	--	0.9	--	--	--	--	--	--	7.2	350†	
Blue Joint 1 & 2	MBMG	08-11-72	2.6	0.1	37.5	0.34	54.	67.	0	3.1	4.8	9.5	--	N.D.	N.D.	N.D.	--	--	--	--	--	--	8.2	145	
Boulder	USGS	08-22-74	2.2	< .1	120.	3.8	110.	161.	4.	19.	74.	11.	--	0.02	< 0.02	--	--	--	--	0.56	--	0.24	8.5	420	
Bozeman	USGS	08-25-74	9.5	2.7	120.	2.8	66.	130.	3.	46.	110.	9.2	--	0.02	0.02	--	--	--	0.5	--	0.20	0.6	0.04	8.6	430
Bridger Canyon	USFW	--	54.8	22.7	4.26	1.4	8.2	209.	0	0.19	80.	0.47	--	< .025	0.001S	0.05	--	--	--	--	--	--	7.7	270	
Broadwater	USGS	08-24-74	11.	0.9	160.	5.8	98.	210.	5.	33.	170.	9.4	--	0.07	0.05	--	--	--	1.1	--	0.80	< .5	0.48	8.5	600
Brooks	USGS	09-23-75	133.	40.3	3.4	1.4	8.9	195.2	0	0.95	336.	1.3	--	< .01	< .01	3.60	--	--	--	--	--	--	7.3	620	
Browns	MBMG																						7.4	480†	
Camas	USGS	09-15-75	1.12	.39	83.	1.8	58.0	112.2	19.2	5.50	43.7	5.7	--	< .01	< .01	1.20	--	--	--	--	--	--	9.1*	270	
Carter's Bridge	MBMG	12-22-78	129.	35.4	7.3	4.1	19.4	187.	0	3.2	307.	1.3	--	< .01	0.01	0.57	--	--	0.0011	0.11	--	0.03	7.8*	600	
Chico	USGS	08-25-74	35.	8.8	35.	6.8	34.	170.	< 1.	10.	41.	0.9	--	< .02	< .02	--	--	11.	--	0.06	0.6	0.03	7.4	250	
Deer Lodge Prison	MBMG	03-27-78	3.9	0.1	45.8	0.5	45.8	40.9	12.5	2.55	33.	7.5	--	< .01	< .01	0.51	--	--	--	--	--	0.07	9.3	170	
Durfee Creek	MBMG	08-15-73	533.	165.	14.0	3.2	12.8	59.	0	4.1	1872.	1.8	--	0.09	0.02	0	--	--	--	--	--	0.04	7.2	2,630	
Elkhorn	USGS	08-20-74	1.9	< .1	48.	0.7	55.	77.	4.	1.7	27.	2.6	--	< .02	< .02	--	--	--	0.02	--	0.04	0.9	0.05	8.9	180
Ennis	USGS	04-01-76	5.8	0.6	340.	17.	96.	442.	0	120.	220.	11.	--	0.02	0.01	--	0.02	14.	0.025	0.61	--	0.26	7.7	1,030	
Gallogly	MBMG	10-07-80	3.0	< .1	42.8	0.7	43.7	63.7	12.2	1.2	12.1	5.8	--	0.005	< .001	0.04	--	--	0.0008	0.05	--	0.09	9.1*	150	
Garrison	MBMG	08-08-72	77.	35.	24.	5.2	16.2	59.	0	3.4	335.	1.3	--	N.D.	N.D.	0.2	--	--	--	--	--	0.15	7.1	530	
Granite	MBMG																						9.3	210†	

TABLE 2 — SPRINGS, WATER ANALYSIS (CONTINUED)

Spring Name	Agency	Dates	Ca	Mg	Na	K	SiO_2	HCO_3	CO_3	Cl	SO_4	F	Na + K	Fe	Mn	NO_3	P	CO_2	As	B	H_2S	Li	Field pH	T.D.S.
Green Springs	HEALTH	01-05-65	N.D.	N.D.	--	--	--	101.	12.	5.	18.	2.2	61.	0.14	--	N.D.	--	--	--	--	--	--	9.2	280†
Gregson	USGS	08-19-74	3.9	< .1	170.	3.9	85.	168.	3.	17.	180.	18.	--	< .02	< .02	--	--	1.1	--	0.30	1.6	0.64	8.4	560
Greyson	MBMG																						7.6	460†
Hunsaker	MBMG	06-26-79	71.2	18.8	22.3	11.4	23.3	325.	0	11.	30.	0.75	--	0.58	0.20	0.18	--	--	0.0034	0.10	--	0.019	6.9	350
Hunters	USGS	07-02-75	< 1.0	< .1	85.	0.6	65.	170.	15.	18.	11.	5.6	--	< .02	< .02	--	--	0.3	--	0.67	5.3	0.03	9.1	280
Jackson	USGS	08-16-74	10.	3.7	240.	10.	52.	610.	< 1.	7.7	45.	2.0	--	< .02	0.04	--	--	155.	--	0.83	0.6	0.32	6.8	660
La Duke	USGS	07-02-75	320.	58.	230.	23.	49.	300.	< 1.	45.	1200.	3.6	--	0.16	0.02	--	--	152.	--	0.46	< 1.0	0.24	6.5	2,080
Landusky 1 & 2	MBMG	08-16-73	266.	86.	39.	9.	18.2	109.	0	18.8	982.	1.5	--	N.D.	N.D.	1.1	--	--	--	--	--	0.09	8.0*	1,480
Landusky Plunge	MBMG	08-16-73	161.	65.	24.	6.7	17.8	101.	0	9.5	620.	1.6	--	N.D.	N.D.	1.1	--	--	--	--	--	0.05	8.1*	960
Little Warm Springs 1, 2, 3	MBMG	08-16-73	289.	110.	72.	13.3	16.	101.	0	59.	1144.	1.4	--	0.10	N.D.	0.1	--	--	--	--	--	0.14	8.1*	1,750
Lodgepole 1, 2, 3	MBMG	08-16-73	268.	96.	75.	13.	16.3	81.	0	57.	1062.	1.1	--	N.D.	N.D.	0.1	--	--	--	--	--	0.14	8.1*	1,630
Lolo	USGS	08-15-74	1.8	< .1	52.	1.2	72.	70.	0.	6.1	18.	6.4	--	< .02	< .02	--	--	0.1	--	0.11	< .5	0.03	9.3	200
Lovells	MBMG																						7.3*	420†
McMenomey Ranch	PRVT.	03-24-78	88.	27.5	28.3	4.5	17.5	217.	0	16.15	191.	0.7	--	< .01	< .01	0.67	.134	--	0.0145	--	--	0.04	7.4*	480
Medicine	USGS	08-16-74	1.9	< .1	80.	1.4	60.	120.	3.	6.7	33.	14.	--	< .02	< .02	--	--	0.5	--	0.12	0.6	0.20	8.6	260
New Biltmore	USGS	08-17-74	290.	73.	160.	24.	46.	230.	< 1.	46.	1100.	3.3	--	0.10	0.03	--	--	58.	--	0.92	1.1	0.18	6.8	1,860
Nimrod	USGS	03-18-72	126.	36.	15.5	3.4	21.	168.	0	2.7	340.	0.8	--	0.01	0.01	0.4	--	--	--	--	--	--	7.7	630
Norris	USGS	08-21-74	17.	3.2	180.	10.	88.	380.	1.	23.	130.	7.4	--	0.02	0.02	--	--	15.	--	0.10	< 1.0	0.09	7.6	640
Pipestone 1 & 2	USGS	08-18-74	2.6	< .1	98.	1.9	66.	100.	4.	20.	94.	5.3	--	< .02	< .02	--	--	0.3	--	0.28	2.3	0.09	8.7	340
Plunkets	MBMG	07-17-79	38.5	23.5	22.4	2.4	15.5	87.2	16.2	9.0	87.	0.7	--	< .002	< .002	3.05	--	--	0.0017	.11	--	0.032	7.8	260
Potosi 1	USGS	08-21-74	10.	< .1	91.	1.6	46.	63.	2.	5.9	140.	6.2	--	< .02	< .02	--	--	0.3	--	< .02	< .5	0.05	8.6	330
Potosi 2 & 3	MBMG	06-25-79	13.2	0.1	94.6	1.7	47.7	67.3	0	6.	170.	6.1	--	0.01	< .01	< .10	--	--	--	0.03	--	0.056	8.4*	360
Pullers	USGS	05-14-76	56.	19.	330.	24.	33.	511.	0	91.	350.	2.2	--	0.04	--	0	0	16.	0.034	0.69	--	0.19	7.7	1,160
Quinn's Hot Springs	MBMG	08-09-72	3.6	0.2	39.2	1.5	76.6	71.	0	3.1	29.	2.1	--	N.D.	N.D.	N.D.	--	--	--	--	--	0.01	8.9	190
Renova	USGS	08-13-76	51.	13.	150.	13.	37.	310.	0	34.	200.	3.0	--	0.08	0.03	--	0.03	14.	0.019	0.48	--	0.13	7.5	650
Silver Star	USGS	08-18-74	9.3	0.3	170.	6.4	110.	170.	2.	31.	190.	8.7	--	< .02	0.02	--	--	1.8	--	0.25	1.0	0.34	8.2	610
Sleeping Child	USGS	08-15-74	5.4	< .1	120.	2.9	66.	170.	2.	9.5	87.	15.	--	< .02	< .02	--	--	1.8	--	0.35	0.8	0.18	8.2	390
Sloan Cow Camp	MBMG	09-29-77	0.9	0.1	88.	1.1	50.9	64.2	74.4	7.65	3.7	3.1	--	0.17	< .01	0.22	--	--	0.002	0.16	0.94	0.01	10.0	260
Staudenmeyer Ranch	MBMG	10-03-77	68.	24.	29.	7.7	21.4	251.	0	9.35	116.	1.8	--	< .01	< .01	0.22	--	--	0.0154	0.23	< .10	0.05	7.6	390
Sun River	MBMG																						7.2	890†
Targhee Sulphur	MBMG	08-23-79	72.9	27.5	7.1	4.5	14.4	63.3	0	1.7	156.	1.1	--	0.01	0.02	--	--	--	0.0151	0.06	--	0.03	6.7	320
Toston	MBMG	06-29-79	48.7	20.2	13.6	3.6	19.8	193.	0	6.8	56.6	0.70	--	< .01	< .01	1.68	--	--	--	0.12	--	0.047	7.5	240
Trudau	MBMG	05-25-78	78.	30.	70.	11.1	19.0	425.	0	18.20	102.	0.8	--	< .01	< .01	0.77	--	--	--	--	--	--	6.4	540
Vigilante	MBMG	05-24-78	84.5	27.	6.7	3.1	15.5	182.	0	1.90	174.	0.9	--	0.01	0.01	0.67	--	--	--	--	--	--	7.5	400
Warm Springs State Hospital	USGS	08-19-74	220.	22.	120.	26.	56.	260.	< 1.	5.0	670.	3.9	--	0.05	0.05	--	--	132.	--	0.10	0.7	0.36	6.5	1,250
Warner	MBMG	06-16-79	25.8	7.2	5.3	0.8	17.1	101.	0.6	1.8	16.4	0.2	--	0.01	< .01	0.97	--	--	0.0009	< .02	--	0.005	8.2	125
West Fork Swimming Hole	MBMG	09-29-77	19.	29.	4.8	1.9	13.7	194.	0	2.75	11.8	0.4	--	< .01	< .01	0.44	--	--	0.0028	0.02	0.17	0.01	8.3	180
White Sulphur Springs	USGS	08-24-74	44.	12.	480.	20.	51.	830.	< 1.	180.	310.	7.4	--	0.11	0.15	--	--	420.	--	9.10	0.7	1.30	6.5	1,530
Wolf Creek	MBMG	09-30-77	8.7	1.6	100.	1.8	50.3	154.	7.3	19.4	42.6	16.	--	< .01	< .01	0.28	--	--	0.005	0.03	0.2	0.07	8.6*	320

All water quality information is in milligrams per liter (mg/L)

Symbol explanations:

-- — Not determined.

N.D. — Not detected, detection limit not known.

* — Laboratory pH.

† — Laboratory value for TDS calculated from specific conductance data using the relationship TDS = 0.75 x SC.

APPENDIX D

Spring Creeks with a flow of less than 5 cfs

or

Need to be inventoried

Table 1. Spring creeks in Montana not included in the inventory and needing investigation.

Region 2

Spring creek in Flint Creek drainage near Phillipsburg, Montana
Spring creek near Drummond, Montana

Region 3

Spring creek in Big Hole River near Wise River, Montana
Bull Run and Hess Spring creeks in E. Gallatin Drainage

Table 2. Spring creeks in Montana with flows of less than 5 cfs

Name	Drainage	Legal Description (At Mouth)
Region 1		
Spring Creek	Flathead	T28N, R23W, Sec.24
Spring Creek	Flathead	T28N, R21W, Sec.07
Spring Creek	Flathead	T28N, R22W, Sec.12
Somers Hatchery Creek	Flathead	T26N, R21W, Sec.28
Sullivan Spring Creek	Flathead	T24N, R24W,
Region 2		
Chamberlain Creek	Blackfoot River	T14N, R13W, Sec. 20
Dry Cottonwood Creek	Nevada Creek	T12N, R11W, Sec. 14
Wales Creek	Blackfoot River	T13N, R13W, Sec. 12
Wet Cottonwood Creek	Nevada Creek	T12N, R10W, Sec. 31
Gallagher Creek	Clark Fork	T11N, R09W, Sec. 06
Liverpool Creek	Blackfoot River	T05N, R06W.
Rock Creek Springs	Clark Fork	T11N, R17W, Sec. 12
Nimrod Springs	Clark Fork	T11N, R15W, Sec. 14
Region 3		
Beaverhead Rock Springs	Beaverhead River	T05S, R07W, Sec. 22
White Rock Springs	Jefferson River	T01S, R05W, Sec. 26
Sappington Springs	Jefferson River	T01S, R01W, Sec. 33